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ABSTRACT

The Organisation for Economic Cooperation and Development's Computer Utilization Group formed a Policy Panel. Its purpose was to assist its member governments by surveying the state of the art of computers and information utilities, to analyze applications and alternative policies relevant to conditions in member countries, and to make policy recommendations. Part I of this report contains the Panel's recommendations that member countries: 1) identify or establish means of coordinating research and operational aspects of computer/communications systems; 2) coordinate large scale experimental programs; and 3) identify analytical procedures to determine cost/benefit criteria, user needs, technical standards, and economic factors. Part II consists of a consultant's background report which deals with economic, technical, and organizational issues. It reviews a) the basic concepts of, interaction between, and interdependence of computers and telecommunications, b) the services offered, c) the dangers of manipulation, d) macro-economic and market entry issues, e) economic and political constraints, and f) national programs. (Author/PB)

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part I - report by the panel on policy issues
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by dieter kimbel

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PREFACE

The Computer Utilisation Group, set up in 1968 by the OECD Committee for Science Policy in response to recommendations of the third Ministerial Meeting on Science, has on its programme studies in the fields of computerised data banks, interaction of computers and telecommunications, computer manpower education, computer utilisation surveys, efficiency audits for computer systems and the potential of information technology in urban and regional planning.

One of the programme items of this group during 1971 was the investigation of policy issues arising from the increasing interaction of computer and communications technologies.

The present report highlights policy issues in this complex field, and consists of two parts:

I. The report and conclusions adopted by the Panel on Policy Issues of Computer/Telecommunications Interaction.

II. The background report prepared by Dieter Kimbel, Consultant to OECD, discusses economic, technical and organisational issues.

The views expressed in the consultant's report are those of the consultant alone and do not necessarily reflect those of the Panel members, their governments or the OECD Secretariat. The Panel conclusions were developed by the Panel members whose names appear on the attached list and consequently do represent their collective opinion. However, they have not been co-ordinated formally with member governments and consequently should not be construed as constituting the official policies or opinions of those governments.

Part One

REPORT BY THE PANEL ON POLICY ISSUES OF COMPUTER/TELECOMMUNICATIONS INTERACTION

I. Terms of Reference of the Panel
II. Statement of Conclusions
III. List of Panel Members

I

TERMS OF REFERENCE OF THE PANEL

General

During the decade of the 1960's the previously disparate technologies of computers and communications came together to create an important new class of combined computer/communications systems. Variously termed "multiple access computer networks", "teleprocessing systems", "computer utilities" or "information utilities", these systems employ telecommunications links and a variety of time- and equipment-sharing techniques to provide directly to customers in their own premises a wide range of information and data processing services. Ideally such utilities should be able to provide each user, whenever he needs it, with the equivalent of a private computer capability responsive to his immediate needs, but at a fraction of the cost of an individually owned system.

The applications of such systems, however, extend far beyond the field of computation. For, in addition to making computer power available in a convenient economical form, they can be concerned with almost any service or function that can in some way be related to the processing, storage, collection and distribution of information. In fact they promise soon to make the computer as much a part of our daily lives as the telephone is today. Out of this widespread availability of "information power", there will flow social changes and opportunities for human development that promise to make the next few decades among the most critical that mankind has even faced. Consequently governments are faced now with many fundamental problems of public policy whose proper resolution is of vital importance to the future of their countries.

OECD Interest

The interest of the OECD in this area arises from the impact on the economies of its member countries that will be made by the rapid growth of the computer/communications industries. To reach this state, however, enormous investments probably running into thousands of millions of dollars will be required by even small countries. The commitment of such sums will obviously require careful planning and allocation of limited national resources. This was recognized by the Committee for Science Policy in its meeting on 19th and 20th March 1970, when it was agreed that :

> "attention should now be clearly focussed on policy aspects of developments in computer technology, and its interaction with information systems and communications networks".

In addition, the Policy Panel of the Computer Utilisation Group, in it's meeting on 4th and 5th June 1970, stated:

> "Although several international organisations are concerned with problems of information and communications, none of them provides an international forum for discussing and developing an integrated approach.
>
> "The OECD is concerned with the quantitative and qualitative aspects of economic growth, all of which have an essential information and communication aspect. This presents the Organisation with a challenge to perform a role as an international focus for an integrated approach in the field of computer/communications policies. OECD representing a homogeneous group of technologically advanced nations, is in an excellent position to meet this challenge."

Scope

It is the purpose of this Panel to assist Member governments by:

- surveying the state of the art and trends in the development of information utilities with specific reference to systems existing and planned in each Member country;
- analysing possible fields of applications and their data processing and communications requirements;
- identifying and evaluating alternative policies that Member countries might follow in exploiting the information utility concept;
- recommending actions that Member countries might take in formulating and implementing their policies in this field.

II

STATEMENT OF CONCLUSIONS

State of the art

The application of integrated computer-telecommunications technologies will have a growing impact on most aspects of social, cultural and economic life. This conclusion stems from the potential increases in effectiveness and productivity that follow the efficient handling of information, coupled with the indications of very large relative growth rates in the computer-communications field.

The chances are great of assessing these science-based technologies successfully in as much as integrated computer-telecommunications systems are still at a relatively early stage in their development and telecommunications are the strategic parameter for all the components that comprise these systems. (For example, it has been estimated that data communications traffic is less than two per cent of all telephone traffic, but is growing at a rate of 50 per cent per year).

Furthermore there is a wide range in the utilisation of this technology at present.

A broad survey of the computer/communications facilities which are now offered to the customer in the various Member countries shows, using population figures for 1970, that the number of inhabitants per data terminal now varies from a minimum value of about 1,100 to a maximum of 40,000. Moreover, the analysis of existing plans and forecasts shows that this relation among countries is not expected to change significantly in the near future. Forecast figures for 1975 range between a minimum value of 250 and a maximum of 7,600 inhabitants per terminal.

Nevertheless, improvements in data communication facilities are envisaged in all Member countries conscious of the tremendous impact of computer/telecommunications interaction.

In order to minimize possible undesirable effects and properly exploit the challenge of these new systems, governments should give immediate attention to such considerations as the following:

- i) decisions on the necessity for and degree to which governments should influence the development of the field of computer/telecommunications systems;
- ii) decisions on amounts of investment to be made in both telecommunications plant and application service bureaux, with consideration of more flexible approaches for acquiring investment capital;
- iii) degree of regulation to be imposed;
- iv) need for greater co-operation in and among appropriate international bodies to ensure compatibility among various national and international systems.

Analysis of applications

The Panel studies have fully confirmed the original assumptions concerning the potential pervasiveness of computer communications systems. Such systems will have a growing impact upon social, economic and cultural life and ultimately could transform the very nature of human society. Although the main emphasis to date has fallen on the fields of administration, finance and remote computing, the potential spectrum of applications is almost infinite. More work, however, is required to establish the viability of applications in the social sectors. A more thorough exploration of applications will be undertaken in OECD symposia planned for the near future. This should involve liason with other appropriate international organisations.

Identification of policies issues

The orderly development of computer/communications systems within a country aimed at social and economic improvement depends on the effectiveness of the overall management of the changing technologies of such systems. This management should flow from national policies, required to serve national goals. In turn, the development of these policies must consider the issues involved and the extent of their interaction.

The Panel considers that, when developing such policies, priority should be given to dimensioning the following issues and to defining the extent of their interaction.

i) Industry structure:

  - degree of competition in the relevant sectors,
  - definition of supplier roles of carriers and computer companies,
  - definition of ownership - public vs. private,
  - source of investment - public vs. private.

ii) Regulatory process that encourages development should have guidelines concerning:

  - tariffs - should they be based on commercial or social objectives,
  - pricing - to what degree should it be cost based vs. value of service,
  - operations - are subsidies required or will systems be profit oriented,
  - user recognition - ease of access to regulator for "grievances".

iii) Define priority of domestic and international objectives that are to be pursued in the development of these systems.

iv) Technology - determine the extent of R and D and pilot programmes to be undertaken and their direction, related to existing telecommunications investment.

Recommendations

The Panel recommends that countries consider taking action to accomplish the following:

i) Establishment or identification of focal points or other appropriate means to co-ordinate on a continuing basis: the research and policy aspects, the operational programmes required in the development of computer/communication systems and the provision of the necessary analytical skills to monitor results both in the home country and other Member countries.

ii) Co-ordination of large scale experimental programmes, when feasible, with other Member countries to reduce redundancy of expenditures and to achieve more effective results.

iii) Developments or identification of analytical procedures to determine effective cost/benefit criteria, forecasts of user needs, technical and software standards, tariff relationships with other telecommunication services and other necessary economic relationships. These should be co-ordinated as appropriate with international organisations such as OECD, ITU, CEPT and ISO.

III

LIST OF MEMBERS OF THE PANEL ON POLICY ISSUES OF COMPUTER/TELECOMMUNICATIONS INTERACTION, WHO ATTENDED THE MEETING OF 6th AND 7th JUNE, 1972

Chairman	Mr. D. F. Parkhill	Assistant Deputy Minister (Planning) Department of Communications, Ottawa, Canada
Australia	Mr. J. M. Ryan	Office of the High Commissioner for Australia, London
Canada	Mr. A. B. Donaldson	Department of Communications, Ottawa
Denmark	Mr. M. D. Rømer	Kommunedata I/S, Copenhagen
Finland	Mr. B. Reitmaa	General Direction of Posts and Telegraphs, Helsinki
	Mr. T. Kasanen	General Direction of Posts and Telegraphs, Helsinki
France	Mme I. Chovet	Ministère des Postes et Télécommunications, Paris
Germany	Mr. H. Wille	Bundesministerium für Wirtschaft und Finanzen, Bonn
	Mr. U. Mohr	Bundesministerium für das Post-und Fernmeldewesen, Bonn

Italy	Mr. P. Masarati	Societa Finanziaria Telefonica, Rome
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	Mr. T. Tomita	Ministry of Posts and Telecommunications, Tokyo
	Mr. Y. Kamata	Ministry of International Trade and Industry, Tokyo
Netherlands	Mr. H. J. Wijers	Centrale Directie PTT, The Hague
	Mr. J. M. van Oorschot	Central State Office for Machinery, The Hague
Spain	Mr. J. Manjarres Hurtado	Compania Telefonica Nacional de Espana, Madrid
Sweden	Mr. P. Svenonius	The Swedish Agency for Administrative Development, Stockholm
	Mr. B. Akesson	Swedish Telecommunications Administration, Farsta
United Kingdom	Mrs. J. M. Goodman	Ministry of Posts and Telecommunications, London
United States	Mr. J. M. Richardson	U. S. Department of Commerce, Washington D. C.
	Mr. P. H. Enslow Jr.	Office of Telecommunications Policy, Washington D. C.

SECRETARIAT: Mr. H. P. Gassmann

Mr. D. Kimbel

Part Two

COMPUTERS AND TELECOMMUNICATIONS

- Economic, Technical and Organisational Issues -

by

Dieter Kimbel

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I

INTRODUCTION

Computers and Telecommunications

It is hard to conceive of any single technology which has as great an impact on society as has that of electric and electronic communications. Telecommunications have become and will become increasingly a vital part of our society and play a major role as catalyst and agent for social change.

Telephone communications which now allow 300 million people to communicate instantaneously are only a minor example. The promises of further important developments such as the videophone and the computer utility, which are almost taken for granted, will have a much more profound impact.

The key to the societal impact of telecommunications technology, particularly through its merger with computer and complementary technologies (micro-fiche, film, video recording) is the services they make possible. Computers and telecommunications cover a gigantic spectrum of diverse services, including mass-media. This means that the projected advances will provide important innovative tools for society, particularly in the service sector, e. g. in health-care and educational services (including those now envisaged such as a "permanent education plan" for adults). Thus the real impact of these technologies will be in the changed nature of performance, in the cost/benefit sense of these services. On a broader scale the societal impact arises from the fact that information, properly organised and instantly accessible, is the foundation of knowledge.

In addition, the computer and telecommunications industries form a large segment of every economy. These technologies promise to be the basis for further quantitative economic growth. This will be discussed in the report as "key industry approach".

To understand the directions in which future communication developments will affect society, it is of course necessary to obtain better insight into anticipated technological progress. This is more difficult than conventional forecasting because, just as telecommunications affect society, so does society and its evolving value systems affect the nature of telecommunications in qualitative and quantitative terms.

To facilitate the exploration of such a complex topic, this study has focused on the agents and institutions which are involved in and responsible for the introduction and operation of these science-based technologies. This approach seems to be justified because the telecommunications industry works in a monopolistic or quasi-monopolistic environment, whereas the computer industry, characterized by rapid technological change, is operating in a highly aggressive, competitive environment, although there are certainly powerful leaders within the industry.

Consequently, it seems clear that current decisions - particularly by the common carriers, but also by related industries, government, business and the public - would benefit greatly from improved insight into the likely future development of telecommunication systems and services.

Objectives of the Report and Study Approach

The original goal for this study was very broad: "to examine the increasing interaction of computers, telecommunications and information systems and their possibilities for society in the '70s". In keeping with this objective an attempt was made to survey early developments in:

- the evolution of communication-related technologies and their expected economics;
- trends in various segments of society and the latter's probable demands for telecommunications services;
- expected institutional arrangements related to computers and telecommunications.

A questionnaire was prepared and distributed to the members of the Panel on Policy Issues of Computer/Telecommunications Interaction. During the five meetings of this Panel, there was an ongoing dialogue and correspondence to obtain the judgement of each member on the questions compiled earlier. In addition, the most relevant literature on computers and telecommunications was reviewed.

Caveats and Limitations

The conclusions and the projections in this report represent performance ranges wherever it was possible to determine them, and the directions in which impact can be expected for those subjects where detailed projections were impossible. This is mainly due to the fact that this was a one-man study and that the following main caveats obtain:

- the majority of the data collected for this study pertains only to the situation at the beginning of 1972. In such a highly dynamic field as computer and telecommunication technology new information (such as the effect of minicomputer-based systems on telecommunications demand) continues to be generated almost daily;
- there is considerable confusion regarding the interaction of economics, policy-making; regulatory, legislative, legal (copyright) and enforcement organisations, due to the newness of the problems confronting all the partners involved;
- the absolute division (in terms of organisations, manpower and interest) was particularly disturbing when a picture of the so-called utility concept of computer and telecommunication systems was sought; in other words there is a computer-community (hardware and software manufacturers, etc.) and the traditional telecommunications community, such as common carriers and/or the PTT administrations. This sharp division of labour, knowledge and planning within these industries (although their boundaries are becoming more and more blurred in terms of techniques and application) became remarkably evident in the answers to the above-mentioned questionnaire. In most Member countries respondents answered only questions relevant to their "specific task", i. e. , the computer industry replied to computer questions and left open telecommunication questions, whereas the common carriers, such as the PTT authorities, replied only to telecommunication questions. The parts of the questionnaire which asked about user requirements (i. e. , the combined applications of both technologies, the underlying philosophy, their parameters, etc.) in general were not answered.

Organisation of the Report

The report presents a condensed account of the main findings on relevant literature, studies within the industries and the data received from the questionnaire. Section II contains a summary of the study's main findings.

In Section III, Chapter 1 looks at the telecommunication/computer concepts within the economic and social contexts.

Chapter 2 discusses present and potential organisational concepts of basic computer/telecommunication systems, and Chapter 3 the social relevance of these merging technologies and their infrastructural character for the service sector, particularly the public services.

Chapter 5 discusses the interdependence of computer and telecommunication facilities from a technical, economic and institutional point of view. It shows that in the computer industry rapid technological progress has led to substantial savings which are reaped by the consumer, due to the competitive environment. In contrast, in the telecommunications industry, tariffs do not show the same trends; rather, they are increasing and becoming the limiting factor within the computer/utility concept.

Chapter 6 discusses how far tariff decreases for all kinds of telecommunications services could be realized with available telecommunications technology. The qualitative and quantitative economic growth aspects of these science-based technologies are highlighted in Chapter 7. Chapter 8 discusses the current state-of-the-art as well as plans of the relevant authorities up to 1980 and the technologies at present available. This chapter should also provide a better understanding of the process through which new technology passes before being applied.

Chapters 9 to 11 deal with the primary findings of the study, grouped into three main topics:

- the monopolistic environment of telecommunications services, with arguments for and against the participation of common carriers in the utility concept;
- trends in the demand for new telecommunications services;
- political and economic constraints to anticipate the new telecommunications requirements.

Finally, Chapters 12 and 13 discuss new institutional arrangements that may evolve in the field of telecommunications and computers on a national and international level.

II

SUMMARY OF MAIN FINDINGS

Due to uncertainties resulting primarily from the ambiguity and inadequacy of the data used, the findings of this report are bound to be tentative. Subject to this proviso, these findings, classified according to the direction and area of impact, are set out below.

Concept of Computer Telecommunications Systems

The computer/telecommunications system has had and will continue to have a deep and increasing impact on all sections of society. This impact will develop at an accelerated pace in the short to medium term.

Due primarily to the high potential organisational advantages there is likely to be an increasing trend away from stand-alone computer systems towards integrated computer/telecommunications resource-sharing systems. This trend is being fostered primarily by an awareness of improved cost-effectiveness, in terms of these new technological possibilities and the opportunity this offers to reorganize information flows.

These emerging "interactive concepts" rest on the three following hardware components: computers, telecommunications facilities and terminals. The telecommunications link brings together "raw" computer power and conveys the information in data banks to the millions of different geographic locations where they are needed. Stand-alone mini-computers at all these dispersed locations can also be used as terminals to the central data banks. The system's overhead costs are shared between many widely dispersed users. This can potentially provide each user with a private computer capability as powerful as the current technology permits, but at a small fraction of the cost of an individually owned system.

Economic and Social Impacts

Emerging computer and telecommunications technologies are expected to have a critical impact on future economic and social development, affecting notably the economics of "sharing" with its manifold implications, the value system, goals and priorities of society, and the social, political, institutional and legal framework.

Despite the limited body of reliable data in respect to these qualitative aspects (priorities, values, goals, etc.) the experts consulted laid particular stress on the important stimulus to innovation stemming from these developments in the following areas:

a) The application of interactive integrated computer/telecommunications systems as a "tool" for increasing the productivity of the service sector;

b) The stimulus to new "key" industries in the production of components and systems to support these networks.

The Service Sector

The projected advances in computers and communications imply considerable innovative stimulus in the provision of new "tools" in the service sectors (medical, legal, educational and other professions) and in a wide range of public services - postal services, education (especial with the advent of education as an "on-going" process), and even pictorial consumer information systems. The measure of the computer/communication systems' impact on the service sectors will be determined by the expected cost/benefit advantages in the provision of these services, the changed life style and the quality of life of individual citizens.

Experts in the field have emphasized the enormous impact these changes in savings can make in the achievement of national goals through better decision-making and policy analysis, at least in part from the introduction of integrated computer/telecommunications systems. For the United States it has been suggested that of some $ 1. 6 trillion the United States Government will spend in the course of the next ten years for social need projects (transportation services, education, health, welfare, retraining, etc.) 10% or more could be saved by the integrated use of these technologies. On the basis of a 10% saving this would be some $ 160 billion which could be reallocated to new services.

It is stressed that governments should establish such computer/telecommunication networks, offering both traditional services (telephones, telex, etc.) and new broad-band consumer services if they are to take advantage of the enormous potential savings. Savings on various United States public services are estimated to be in the region of:

National Services	Most Likely Saving
Domestic Air Travel	over $6 billion
Highways	over $6 billion
Police Protection	over $3 billion
Post Office	nearly $6 billion
Fire Protection	over $1 billion
Recreation	over $28 billion

Key Industry Consideration

With respect to the quantitative impact on economic growth, computer/telecommunications technologies promise to become a key industry within the next ten years.

Technical and Economic Constraints

To exploit these opportunities, the strong technical, economic and institutional interdependence of the computer and telecommunications systems should not be overlooked.

Technical Constraints

At present the merging of these systems - primarily computers and the public switching networks that have been separately designed and operated until recently - meets serious technical, economic and institutional constraints.

The public telephone network was designed for voice communications, with its particular requirements expressed in terms of quality, quantity and channel band-width. The needs for data transmission as the vehicle of the resource-sharing concept are not conveniently met by existing networks. There are inherent inadequacies in the transmitting of data over the telephone. Because of band-width and switching limitations many of the sophisticated applications cannot be realised.

Economic Constraints

Apart from technical problems, there are important economic bottlenecks, notably national tariffs, that limit the proliferation of computer/telecommunications systems and their applications. The underlying pricing philosophy assumes length, time and distance for voice communications tariffs. Data transmission service users would prefer flat rates or a tariff(s) based on information transmitted, geared to meet this particular need. The Member countries particularly disadvantaged are those where telecommunication tariffs are subject to political considerations; for example there is often pressure to cross-subsidise in order to carry unprofitable postal services. As a consequence of these pressures on pricing and investment policies, investment in traditional and advanced telecommunication systems has been sub-optimum.

Consequently, there are reasonable fears that the technical constraints of existing networks and the very high costs of telecommunication services may prove to be the limiting factors in the future growth of this industry and the proliferations of important services. Telecommunications gives vital strategic leverage. Therefore a sound policy framework is a prerequisite if the enormous potential economic and social advantages are to be exploited to the full public interest.

Institutional Interdependence

Because the technological advances in computers and telecommunications are taking place in a particular market environment, the responsibilities of the partners involved must be taken into serious consideration.

a) Computer Industry

Although there is considerable leadership domination in the computer industry nonetheless, due to strong competitive market forces, rapid technological progress has been made, and the real benefits have been passed on to the user. In the past few years, computer hardware prices have dropped sharply. The cost of raw computer power has declined by an order of magnitude every four years, and there is good reason to believe that this trend will continue. On the other hand, the problem of compatibility between the various computer systems is still prominent. Most experts have commented on the chaos of existing "systems standards". A "computer standard", vital for the resource-sharing concept, is therefore considered essential, though it is unlikely to be forthcoming from the computer industry itself without considerable pressure from users or governments.

b) Telecommunications Industry

The telecommunications industry in most OECD Member countries operates in a monopolistic environment. Therefore, the growth rate of teleprocessing and the quantitative and qualitative economies resulting from its application in the service sector will depend on the rate at which new telecommunications services are offered and telecommunications tariffs fall. Thus, the government administrations which operate telecommunications as monopolies, and government agencies which have to ensure that the franchised common carriers respond in good time to users' needs, face tremendous responsibilities and opportunities.

Through appropriate telecommunications policies and plans they could ensure:

- a rapid proliferation of these technologies in the sense of a controlled innovation process;
- the provision of guidelines for the relevant industries, in terms of standards.

State of the Art Planned Activities in the Field of Telecommunications

No country has yet developed a set of telecommunication policies and plans to deal in an integrated manner with traditional and new telecommunication services, although Canada and Japan have made impressive first steps in this direction. Some common carriers seem to be moving only towards an upgrading of existing telephone and telex networks.

Political and Institutional Constraints

Although there have been tremendous technological advances in the field of telecommunications, their introduction into the market is much slower than in the computer industry. This seems to be largely due to the following facts:

- lack or absence of competition
- patterns of depreciation rates
- management attitudes.

For many telecommunication services the following annual budgeting factors constrain long range policies to guide the development and to control the impact of computer/telecommunication advances so as to optimize the benefits to the community. As a result:

a) available investment resources are sub-optimum,

b) funds are allocated for a single financial year, with the result that telecommunications administrations do not know what amounts will be available in the future and are unable to plan investments over a long enough period, and

c) administration are subject to general macro "anticyclical" policy characterised by stop-go behaviour.

The situation is even more difficult in those countries where PTT administrations are obliged to operate postal and telecommunication services applying an average cost-covering principle. As the postal services in most of these countries report heavy deficits annually, the lucrative telecommunications services with their large operating surpluses are used to cover postal deficits. This horizontal transfer of revenues cuts the resources available for the introduction of new telecommunications technologies. In the past this has led to unequal development of telephone services between countries and it is feared that these countries will have a similar experience in the development of new services. This entails heavy opportunity costs, in that the economies the new technologies offer cannot be realized on a sufficiently large scale to provide the necessary stimulus to growth in the new "maker" industries.

The Competition Issues

To exploit the potential benefits which have been summarized under the headings infrastructure and key industries the report highlights the particular market structure of the telecommunications industry. This is characteristically monopolistic on both the supply side of services and the equipment side.

a) Competition in Telecommunications Services

In the United States, additional price advantages and qualitative improvement of services for the community are expected to come from the increased competition in both new and traditional (telephone) telecommunications services. This was initiated by the Federal Communications Commission's landmark decision to allow Datran and MCI to become specialized Common Carriers. This decision removed the absolute market protection of established Common Carriers and permitted new carriers to enter the market. Tariffs for data communications services in particular have dropped between 51% and 85% in those areas in which these specialized carriers have begun to operate since the decision. Market entry issues are discussed in greater detail in Chapter 9.

b) Competition on the Equipment Supply Markets

There is an equal need to foster a more receptive environment for the introduction of increased competition into the common carrier-equipment supply relationship. For the United States this has been achieved with the announcement of the FCC's decision to allow the independent supply of interconnection and terminal attachments (the foreign attachment issues). This decision has been taken in the belief that it will not harm the system. Meanwhile, supported by technical expertize from the National Academy of Science, subsequent experience revealed no significant losses in the technical integrity and viability of the network. On the economic side the tackling of the attachment issue has drastically changed the business situation. Since then the potential for entry into the communications markets has been stimulated and the established Common Carriers subjected to increased competition.

Within other OECD Member countries the Common Carrier or the PTT administrations still produce all telecommunication facilities almost exclusively themselves or are served by a small number of exclusive manufacturers. Thus, even on the equipment supply side there is very little, if any, competition. There is good reason to believe that the public interest would be served best, in the supply of both traditional and new telecommunication equipment and the service provided, if competition were to be stimulated. The following figures provide a measure of possible benefits to be derived from increased competition; in the United States the average cost to the carrier in 1969 to install a telephone was $ 500; this compared with a standard $ 1,000 for most European countries.

III

THE INTERACTION OF COMPUTERS AND TELECOMMUNICATIONS

Chapter 1

GENERAL REMARKS

1.1 THE IMPORTANCE OF COMPUTER/TELECOMMUNICATIONS INTERACTION

During the 1960s the formerly disparate technologies of digital computers and telecommunications merged to create a new class of combined computer/telecommunications systems. Although these systems are well developed and have left the laboratory stage, in technical terms they are not as well defined with respect to concepts and possibilities. The following terms, for instance, are most often used in this study: multiple-compiler-networks, tele-data processing, remote access computer systems, real-time-on-line computer systems, computer and information utilities. *

These systems use telecommunication links and a variety of terminal equipment and time-sharing techniques. The telecommunication links bring the capabilities of computers (raw computer power, for example) and the information in data banks to the millions of locations requiring them. The system over-head costs are shared among many users who are widely dispersed. "Ideally, such a utility would provide each user, whenever he needed it, with a private computer capability as powerful as the current technology permitted but at a small fraction of the cost of an individually owned system". **

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* Definitions of technical terms are contained in the text where appropriate and also in the glossary of terms.

** Parkhill, D.F., The Challenge of the Computer Utility, 1969, p. 3.

The application of such systems, however, extends far beyond the field of computation. In addition to making computer power available in a convenient, economical form, the computer-telecommunications systems may concern almost any service or function related in some way to the:

- collection,
- processing,
- storage,
- manipulation,
- distribution

of information. Consequently, these systems cut across all sectors of an economy:

- as a production factor (similar to capital and labour);
- as an incentive to further economic industrial growth (key-industry approach).

Indeed, many authorities predict that the computer-telecommunications industries will become one of the three key growth industries by the end of this decade. Out of this wide-spread distribution and utilisation of computer power, or "information power", will flow economic and social changes and opportunities for human development that promise to make the next few decades among the most critical that man has ever faced. As a result, governments are already confronted with fundamental problems of law and public policy of vital importance to the future of their countries and the way of life of their citizens.

Among the problems involved are i) the implications which these technologies hold for the computer industry, the communications industry and the general public, ii) the kinds of systems and services which should be built, and iii) the institutions and policies needed to encourage and guide their growth rate harmoniously among OECD Member countries.

1.2 OECD's INTEREST

Such considerations should make it evident from the beginning that OECD's interest is the assessment of both computer and telecommunications technologies in terms of their economically feasible applications and impact on society. The innovation and diffusion of these technologies promise to provide a basis for both qualitative and quantitative economic growth and to have an important influence on the competitive positions of OECD Member countries in world markets in the coming decade.

This presents the Organisation with a challenge: to become the international centre for an integrated approach to computer/telecommunications assessment policies, particularly since Member countries represent a relatively homogeneous group of technologically advanced nations.

In assessing computer and telecommunications technologies the following are of special concern:

a) Macro-economic aspects of computers and telecommunications

On the macro-economic level the order of magnitude of economic growth potential has been set by two recent American forecasts which predict that automation of integrated computer/telecommunications systems within the service sector, by the resultant savings and increased productivity, will cut annual costs by 10% without reducing the quality or quantity of the services now provided. This means either a tax-free year every ten years or a freeing of resources for urgent, socially relevant projects which governments cannot undertake at present.

The industrial growth potential of the computer and telecommunications industries is just as impressive. American experts estimate that by 1980 some $ 260 billion will have been invested: $ 160 billion in computer systems and $ 100 billion for expansion and improvement of telecommunications networks.*

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* Business Week, 6th December, 1969 and 6th November, 1971. Ted Merill, author of this article, has based these "guesstimates" on discussions with IBM, AT and T, Diebold and the various trade associations. His "guesstimates" are supported by two top official AT and T statements (AT and T has 80% of the United States telephones and 100% of the long lines): an annual capital expenditure growth rate of 3% to 5%, starting with the base year of $ 7.5 billion in expenditure for 1971, will total between $ 86 and $ 94 billion for the seventies: that three-fourths of AT and T's 1980 plant is yet to be built. As AT and T's plant is now valued at $ 50 billion, that would call for an expenditure of $ 150 billion in the seventies. With respect to the $ 160 billion anticipated capital expenditures (not accounting for inflation) the following considerations are of importance:

IBM would not speak for itself, but only for the industry. Jack Naughten, Director of Advanced Market Development, said that, if the $ 100 billion figure is just hardware, it is far too high. If it includes other services, supplies, costs of programming, etc., it would be a reasonable figure for the industry.

Saul Padwo, BDC/DOC electronics specialist, pointed out, however, that no one knows how to measure the extent of money spent on the use of information processing systems. Citing a 12% annual growth in main frame production, a 17% annual increase in peripheral equipment, and a 17% to 20% annual increase in software, a grand total of $ 200 billion would not be far off.

(SOURCE: Private information of Dr. John Richardson, Office of Telecommunications, United States Department of Commerce, 27th January, 1972).

Failure in other countries now to initiate careful planning will cause economic opportunity penalties, such as loss of competitive world market position, out-dated technological know-how and production structures, as well as serious political conflicts over such matters as sovereignty aspects (to be considered in more detail later). Thus, in the absence of a primary technology, another cannot be developed. A common analogy illustrating this interdependence is cars and roads.

b) Integrated and balanced approaches

The term "integrated approach" is used here to emphasize that computer and telecommunication technologies must be seen together from a technical as well as from an economic and organisational point of view. It is not enough simply to see the technical interaction of both technologies. Questions concerning the implications of present and potentially feasible applications for the capacity and design of the communications network must also be asked, thereby involving such questions as pricing, structure of common carriers, etc. As for balanced approaches, the term involves consideration of present and future applications of a system and their social impact.

The questions at stake might be summarised as follows: what will happen to the individual consumer when a "cashless" society (money and cheques replaced by a computer-controlled credit card system, such as the SIBOL project now undergoing feasibility studies in Sweden; a computerised banking-payment-system which includes industry, is in operation? The urgent need to discuss these problems is evident if one imagines a credit card system providing banks and industry with information stores, exactly when, etc. With such a detailed pattern of consumer-spending the danger of consumer manipulation - already a matter of dissatisfaction and concern - would become very real unless counterbalancing measures, such as a computerised information retrieval system for consumers, are developed at a very early date.

c) Managerial challenge

As technical trends and the urgent need for computer/telecommunication systems become more and more evident, the need to make technical, economic and political plans for the creation of telecommunication-based information systems represents a managerial challenge of major importance.

The preparation of such plans would be a milestone in history: for the first time the distribution of a major technological change could be planned and directed in the public interest with the likely social consequences taken into prior account.* The alternative is to proceed as in the past, i. e. , to be the unwitting victims of an unplanned technological development, resulting in a multitude of non-compatible systems, individual objectives and unnecessary expense, brought on by a failure to plan and integrate technologies beforehand.

During the first industrial revolution there may have been a general awareness that momentous changes were occurring, but there was no realisation on the part of the public of the extent to which the process could be subjected to rational control. As a result the brutal doctrine of laissez-faire was pursued with all the disadvantages implied in terms of human degradation and gratuitous suffering, pollution and uncontrolled developments in urban areas.

It is not an academic argument to state that a "biased" development, i. e. based on interest group pressures, seems to proliferate. Recent examination of future data-transmission markets seems to be exclusively based on the future needs of commercial industries. **

In the absence of any long-range public strategy, this might lead to a wide range of independent private networks in each country, causing inter-connection difficulties similar to those at present in the international scene with all the attendant opportunity costs, both in political and economic terms.

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* The importance of anticipating the social implications of developments in science and technology for the 1970s and governments' responsibility was recently a theme for the Fourth Ministerial Meeting on Science by Dr. Heffner.

** DATRAN: Data Transmission Company, United States: the commercial sectors and their proportions of the data transmission market in 1980 are expected to be: insurance, 1%; manufacturing, 1%; securities industry, 2%; health care, 8%; banking and finance, 12%; information services, 23%; and retailing 53%.
(Source: A Preliminary Survey of Data Communications in the United States, edited by John M. Richardson and Robert Gary, p. 6.)

Chapter 2

CLASSIFICATION AND BASIC COMPUTER/ TELECOMMUNICATIONS CONCEPTS

2.1 THE SECOND INDUSTRIAL REVOLUTION

The marriage of computer/telecommunications technology is often referred to as the beginning of the second industrial revolution. The first industrial revolution depended primarily on the invention of the steam engine to harness physical power. The computer/telecommunication era, which may characterise the last quarter of the 20th century, depends on harnessing mechanised logic and stored information in an undefinable variety of applications. Martin* classifies the first revolution as man's attempt to create an extension of his muscles, the second as his attempt to create an extension of his brain. Both "revolutions" have this in common: they need means of transportation and distribution. The sources of physical energy, such as electricity, gas, and water of the original industrial revolution, needed means of transportation. The lack of transportation and distribution facilities during the era of industrial development is said to be primarily responsible for the concentration of industry within certain areas, causing severe social costs today.

Transportation and distribution are likewise of great importance for the "second revolution". It would be impossible and economically not feasible to have a giant set of computer files duplicating data everywhere they are needed; similarly, it would cost too much to have a powerful computer every place it is wanted.

In the first industrial revolution the means of transportation and distribution lagged seriously behind the need for them. Today there is a similar lack of computing facilities, varying, however, in degree from country to country. The degree and character of the existing "transportation bottle-necks" might be identified as being of a technical, economic and institutional nature.

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* Martin, James, Telecommunications and the Computer, 1969, p. 4.

2.2 SIGNIFICANCE FOR MANKIND

It can be seen from the wide range of applications that computer/telecommunications technology is destined to make a major impact on society. In fact its social importance is implicit in the very term "information", for information is in a fundamental sense "the basic stuff of human society". *

A computer/telecommunications system organised as an ubiquitous network might be compared to a body's "nervous system", for it is the electronic telecommunications infrastructure of the economy. Consequently, quantum jumps in man's ability to collect, retrieve and manipulate information will accompany and effect fundamental changes in the nature and quality of societies.

It is predicted that the post-industrial society will be an "instant" one and that almost every activity, whether in art, science, education, government or industry, will centre on and in fact function through the ubiquitous computer network.

Of all the new technologies which have burst upon society in recent years - rocketry, nuclear energy, radically new medical techniques - there is general agreement that the technology of communication is the most important. The others altered the physical environment; but telecommunications can directly alter mankind's knowledge, values, prejudices and cultural pattern.

To administer increasingly complex societies one is forced to think less of computers, telecommunications and information as separate entities and more in terms of a "total information concept". This must be done if one's intention is to guide progress towards desired ends rather than simply react to change.

The potential importance of a "total information" system in post-industrial society is difficult for the layman to grasp or even for the expert to express. Here one might cite Nigel Calder to good effect:

"Indeed, the only way fully to grasp the potentiality of combining computers with modern communications, and to judge what part they will play in daily life and in the work of the community, is to think of a system incorporating the computing, publishing, newspaper, broadcasting, library, telephone and postal services of the country, together with large

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* Sackman, H., "The Information Utility, Science and Society", in The Information Utility and Social Choice, p. 143 ff.

slices of teaching, of government, of industrial and commercial operations, and of many professional activities". *

2.3 THE SHARING OF COMPUTER POWER

The growth of computer centres into regional, national and international networks is the subject of this report. The goal of the computer utility concept is - as defined at the beginning - to share among customers who are geographically far apart the complex commodity embracing "raw computer power" and the various computer services.

The key to these systems is the term "remote", i. e. , the means by which this "computer power" (which physically includes such elements as a mass storage system, a working memory and a data processing unit) is shared. The user of these new services no longer needs to be located next to the computer site, but can gain access to the computer via remote terminals attached to telecommunication lines. In other words, the former physical transportation of data by messenger or mail (slow, and subject to weather and traffic conditions) between the customer and the central processing unit, can now be done by communication links. (A communication link or a channel may be defined as a path for electrical transmission of signals representing information between two or more stations or terminals).

Consequently, the computer utility concept may be defined as the sum of two systems: computers and telecommunication facilities. This definition involves complex combinations of such factors as:

- time;
- computation speeds;
- instruction repertoires;
- data and procedure bases;

on the computer side and

- peripheral equipment characteristics and usages;
- communication speeds;
- communication capacities;
- access time to the system

on the communication side.

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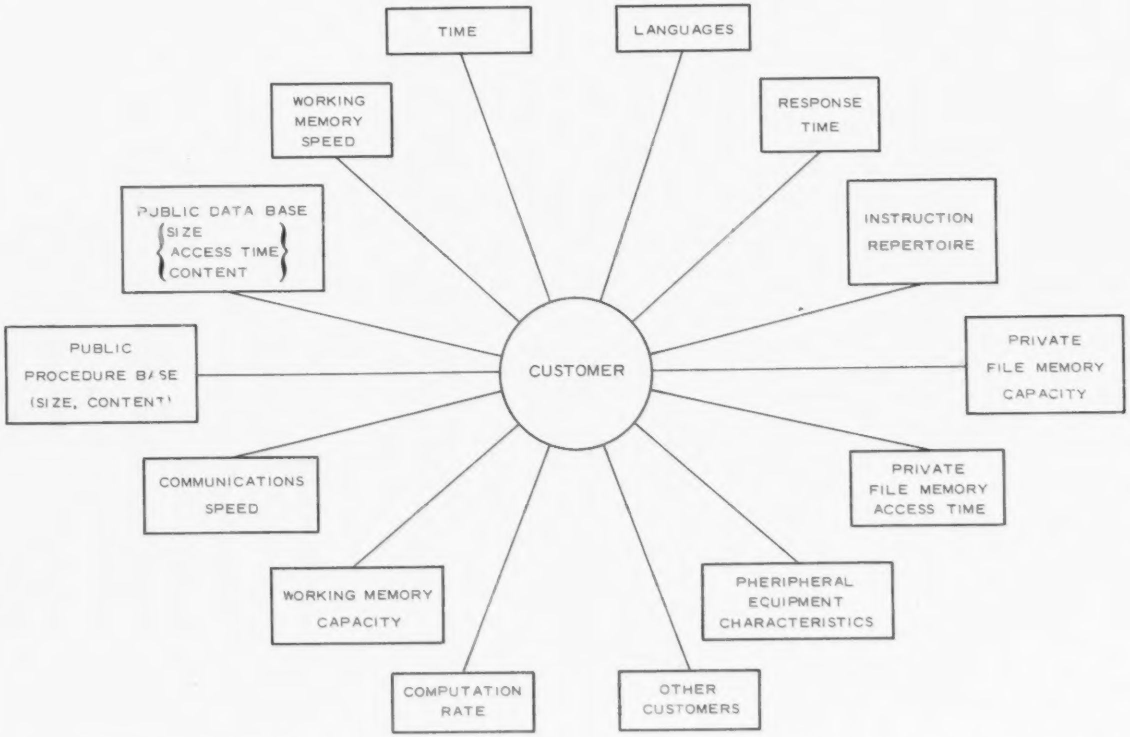
* Calder, Nigel, Technopolis, Social Control of the Uses of Science, MacGibbon and Kee Ltd., 1969, p. 208.

Table 1

THE MANY DIMENSIONS OF COMPUTER POWER


TIME
LANGUAGES
WORKING MEMORY SPEED
RESPONSE TIME
PUBLIC DATA BASE {SIZE ACCESS TIME CONTENT}
INSTRUCTION REPERTOIRE
PUBLIC PROCEDURE BASE (SIZE, CONTENT)
CUSTOMER
PRIVATE FILE MEMORY CAPACITY
COMMUNICATIONS SPEED
PRIVATE FILE MEMORY ACCESS TIME
WORKING MEMORY CAPACITY
PHERIPHERAL EQUIPMENT CHARACTERISTICS
COMPUTATION RATE
OTHER CUSTOMERS

Source: Telecommission, Study 5(a) Policy Considerations with Respect to Computer Utilities, The Department of Communications, Canada, 1971, p. 6.

Table 1 is an attempt to portray something of the complexity involved.

2.4 BASIC COMPUTER UTILITY CATEGORIES

As mentioned before, not only is the system a complex commodity, but its configuration and the ways computer power can be conveyed to the customer are manifold. They may be categorised by a functional, operational or institutional mode as follows:

a) Functional mode

Special or general purpose applications may be distinguished according to the program written for the system.

- Special purpose - typical applications of this kind are reservation and stock quotation systems. In this system the central processor is restricted to the performance of a single function or a group of related tasks specified in advance by the system designer.
- General purpose - in contrast to the above system, specially tailored for one application, the general purpose system can handle many different kinds of tasks, but within the limits of any general task for which a digital computer program can be written.

b) Operational mode

- Batch oriented - in this system each customer's programme is handled on a queuing or scheduled basis with fixed priorities, i.e., completing Customer A's work before going to Customer B, etc. The operation here is similar to that in a normal service bureau; the batch processor operates under the control of an "operating system" (except for the fact that with telecommunications the data and programmes can be transmitted directly between the user and the computer).
- Responsive and/or time sharing - the term "responsive" carries the connotation of immediate access or "real time" operation; it is made economically feasible through techniques known as time sharing. In a time sharing system the computer has many users and switches its attention from one to another at high speed, i.e., at a rate that is rapid in comparison to human response time. By dividing its work into small sections and scanning from one user to another, programmes are multiplexed together

in a continuously repeating cycle. Ideally the length of this cycle is short enough to leave any single customer at a remote terminal console unaware of the intermittent nature of the service rendered; he has the impression of being the sole user of the system. Some authorities reserve the phrase "time sharing" for this type of system; some include all on-line real time systems in this category. Others extend its usage to other types of systems performing several tasks at once. The term "multi-access-system" is also used in reference to computer systems with many on-line users.

c) Institutional mode

The distinguishing characteristic in this instance is the ownership of the system which makes it possible to differentiate between private and public computer systems.

Public systems offer their services to any customer who wants to subscribe. CDC's CYBERNET service, for example, has a network with the following capabilities:

- super computer processing;
- remote access;
- multi-centre network;
- interactive data record management;
- conversational time sharing;
- a library of warranted applications programmes.

Private systems are those whose use is restricted to members of the holding organisation. An example is the Ford Motor Company's network.

Another interesting example of a private service is the SITA High Level network. * Neither a computer manufacturer nor a common carrier provides this service, but rather a group of airline users employing leased and public communication lines in an excellent configuration. This is a somewhat unique situation in view of the fact that communications and switching, normally a "natural monopoly", are used in a service that does a number of different tasks (seat, hotel and car reservations) for SITA members.

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* SITA = Société internationale de télécommunications aéronautiques. SITA is a co-operative, non-profit organisation of airline companies, with headquarters in Paris.

2.5 COMPUTER-SERVICE BUSINESS CATEGORIES

These categories of computer utilities have three distinct elements:

- The basic computer facilities - central hardware* and "executive system"**. (Their product was formerly termed "raw computer power").
- The telecommunication system, which interconnects by means of circuits (telecommunication channels as electric paths):
  - machine (central processor) to machine (data bank application);
  - subscriber to central processor;
  - subscriber to subscriber: the telecommunications may either be switched (as with the telephone trunk network) or permanently connected (leased line)
- The service provided by the system utility - for example payroll service, monetary control, information storage and retrieval, invoice generation, etc.

These functional elements provide a basis for categorising the many different types of businesses that exist or might exist within the computer/telecommunication complex. The crucial question here is, who provides which service, singly or in what combination ? This touches on the question of whether common carriers should provide telecommunications alone or computer power and services as well, or whether non-common-carriers, such as computer manufacturers, service bureaux and others, could or should enter the telecommunications market too, in which case, how ?

The Canadian report, "Policy Considerations with Respect to Computer Utilities"***, identifies the following business categories:

- supplier of remote computer services;
- integrated supplier of special services;
- purveyor of raw computer power;
- telecommunications computer utility carrier;

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* Central hardware might include a central processor unit (CPU), a storage system (core, drums, discs, tape, etc.), a working memory, etc.

** The "executive system" comprises both hardware and software, viz., IFIP-ICC definition: "An executive programme designed to organise and regulate the flow of work in the data processing system". See IFIP-ICC Vocabulary (IFIP-ICC = International Federation for Information Processing - International Computation Center).

*** Telecommission Study 5 a), c), d), e), pp. 8-12.

- independent service retailer;
- total computer utility;
- public computer utility.

a) Supplier of remote computer services

This type of business operates centralised computer centres and makes raw computer power available via cable to remote terminals of the customer. In addition, most organisations supplying such service also provide a host of special application programmes. This kind of service bureau is mostly maintained by major independent bureaux and the large EDP manufacturers, such as IBM, GE, GE-Bull, CDC, ICL and Siemens, to name a few.

Parkhill's example* of balancing the load on a computer utility is derived from the fact that the rotation of the earth leads to time-shifts which are reflected in a corresponding shift in peak load time. This, given reasonably economical wideband communication channels such as, for example, those offered by satellites, the excess capacity of one utility during periods of decreased demand could be used to augment the capacity of another utility whose demand is coming up to a peak.

b) Integrated supplier of special services

The characteristic of this business category is the fact that it does not sell raw computer power but rather its services to customers who are non-programmers. The services are made possible by special packaged programmes tailored for special applications.

Examples of this type are Keydata Corporation's accounting service, or Bunker Ramo's share quotation service. Keydata's services include professional billing for doctors, etc.; Bunker Ramo offers a stock quotation service to the brokerage community with order entry, inventory checking, and up-dating and credit checking.

c) Purveyor of raw computer power

This type of service offers the use of the computer utility. It is a sub-division of the "supplier of remote computer services" category, as it offers raw computer power but does not supply many application programmes other than compilers* and information retrieval programmes.

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* Parkhill, Douglas, The Challenge of the Computer Utility, Addison-Wesley, 1966, p. 143.

d) Telecommunications/computer utility carrier

For technical, personnel and economic reasons this business category aims at integrating traditional telecommunications, such as telephone, telex, etc. ; with the computer utility, since both use the same transmission and switching media. The characteristic of such a hybrid organisation would be that it could supply both traditional telecommunications and raw computer power over existing telephone networks.

e) Independent service retailer

Distinct from the business categories described as purveyor of raw computer poser and telecommunications/computer utility carrier, these organisations do not own, but rather sell surplus memory capacity and processing capability of all the above-mentioned organisations. They fill these "memory spaces" and CPU capabilities (i. e. , raw computer power) with their customers' and their own data and programmes. The independent service retailer offers "application service" conveyed to remote customers by the facilities of such telecommunication carriers as AT and T or the PTT administrations. (The computer power sharing concept between many remote users is defined as sharing the overhead costs which translate into lower prices.)

With proper encouragement and early establishment of compatibility on the computer utility side, as well as the transmission side, this type of organisation could be the instrument for a rapid growth of the application services industry.

f) Total computer utility

As an alternative to the sort of functional segmentation of the industry implied by the preceding categories, the Canadian report** envisages an integration of application services, communication facilities and computer power, in a monolithic company operating as a "Total Computer Utility". In fact, as common carriers are considered a "natural monopoly" in most OECD countries and are often written into the Constitution as such, this concept merits serious discussion. Western Union and UCC in the United States are working in these directions. Both are engaged in every facet of the computer utility, providing their customers with any desired mix of raw computer power, data transmission and switching, and application services.

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* viz., the IFIP definition: "A program designed to transform (e.g. translate), assemble and structure programmes expressed in terms of one language (e.g., a procedure-oriented language) into equivalent programmes expressed in a computer language - which is used within the purveyors' centre."

** Telecommission Study, op. cit., p. 11.

g) Public computer utility

As the term implies, these systems supply computer power to many customers outside the owner organisation. The systems have generated the greatest interest and have led to the term "public computer utility". The interest is explained by the promises of making both digital and analogue data information services available to school, home, laboratory and business on a common basis, similar to other utility services, such as water, gas, electricity and telephone.

Examples of these public computer utilities already operating to some extent are to be found in the United Kingdom and the Federal Republic of Germany: the National Data Processing Service (NDPS)* of the British Post Office Corporation and the Datel GmbH. **

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* It is interesting to note that the British Telecommunication Carrier (the former GPO) entered the highly competitive data processing market before it became a public corporation: - Post Office (Data Processing Service) Act, 1967 (NDPS).
- Post Office Act, 1969.

** Datel GmbH should not be confused with the "Datel Service" a general term for all data-transmission services of common carriers. The shares of Datel GmbH are distributed as follows: Deutsche Bundespost, 40%; Siemens, Telefunken, Nixdorf, each 20%. (Recently Nixdorf and AEG Telefunken signed a joint research and marketing agreement.)

Chapter 3

COMPUTER/TELECOMMUNICATIONS SYSTEMS AND THE SERVICE SECTOR

3.1 GENERAL REMARKS

In the introduction to this report computer/telecommunications systems were characterized as allowing remote and instant, i.e. "real time", access to data and information as well as the manipulation of such data and information. The following definitions may alleviate the considerable semantic difficulties arising from the terms "data" and "information".

- data: "a representation of facts or ideas in a formalized manner capable of being communicated or manipulated by some process";
- information: "the meaning a human assigns to data by means of the known conventions used in its representations". *

The various meanings of "real time" will be discussed. Generally it refers to both data and information, introducing them into a system at the time of their occurrence and having access to them for any kind of manipulation.

These capabilities have been the major argument in favour of employing data-processing systems in general. The technical advances which have made the computer/telecommunications concept possible, however, have widened the range of applications which for technical and economic reasons were previously impossible.

To summarize. **

> It is now technically feasible to bring the full-scale computer complex to anyone in the world served by suitable telecommunication facilities.

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* IFIP-ICC Vocabulary, p.3.

** Telecommission Study, p. 12.

- The interaction between the central computer and the remote user is essentially instantaneous, so that the user receives services indistinguishable from those he would receive if he were physically present in the same room as the computer.
- The cost to each user is only a small fraction of what it would be if the same services were provided by individually-owned computers.
- The separate achievements and data collections of many individuals can be pooled in large public files so that their contents become simultaneously available on demand to all subscribers.
- The technique of time-sharing has made direct dialogue between man and computer economically practicable.
- The interaction between man and computer allows a harmonious blending of the capabilities of each.
- Computer/telecommunications systems have been successfully applied to many fields, such as engineering design, information retrieval, medical diagnosis, problem solving and computer programming.

Where automation and productivity improvement is concerned, the service sector promises to become a considerable field for applications of integrated computer/telecommunications systems. According to economic theory an economy is generally divided into three sectors: agriculture, industry and services. In the book "The Service Economy", Victor Fuchs* defines the service sector as including the private industrial divisions of trade, finance, insurance and real estate, personal and professional services and general government services.

Whereas industrial and agricultural production were early subject to automation, resulting in higher real incomes and more real goods both in quantitative and qualitative terms, it was not possible to exploit technical progress and productivity increases in the service sector to the same degree.

The service sector can be characterized as a large "processor" of data and its efficiency could therefore be measured by;

- the degree of sophistication of the output,
- the allocation and sophistication of human resources,
- the time consumed to provide services.

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* Fuchs, Victor, R., The Service Economy, National Bureau of Economic Research, New York, Columbia University Press, 1968. General Series No. 87.

Computer/communication technologies can obviously make a major contribution to the automation and improvement of activities in the service sector. As most of these services could run on or even through those integrate systems, they could have the impact of the steam engine in the first industrial revolution. Their macro-economic impact may be illustrated in the following considerations.

Some economists argue that the lack of increase in productivity is a cause of inflation, since wages are increasing more rapidly than productivity (see Table 4). A look at the structure of the economies of OECD countries shows the importance of the computer/communication complex in the productivity picture. Tables 2 and 3 indicate that almost half the active population in most of their economies is engaged in some kind of service activity, including education, health care and government. Thus the organisation and behaviour of this economic sector is a main contributor to qualitative and quantitative economic growth. Even more so as an increase in the service sector is noticeable in all Member countries.

It is estimated that in 1980, 65% of all American civilian employees will be engaged in service industries. In the employment context this implies that nine out of every ten new jobs created within this time span will be in the service sector. *

There are additional motivations for the introduction of computer/telecommunications systems in the service sector:

- There is no longer any justification for excluding employees in the largest economic sector from the increases in real income allowed in other sectors, merely on the grounds that productivity increases here are small. Social disturbance and inflationary tendencies could thus be prevented by means of the new technologies.
- Since this sector is not attractive in terms of income categories, it already suffers from a considerable lack of highly qualified manpower, resulting in bad and expensive services. It is not an exaggeration to say that the quality of life is thereby severely affected.
- We have now reached a stage in man's learning when the quantity of information being generated in industry, governments and the academic world is reaching alarming proportions; this is euphemistically, and wrongly termed "the information explosion" - wrongly, because explosions end their violent growth suddenly

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* David, E. Jr., Science Adviser to the United States President, "Computers and the Nation", in Computers and Automation, September 1971, p. 13.

Table 2

CHANGES IN ECONOMIC SECTORS EXPRESSED IN TERMS OF CIVILIAN EMPLOYMENT 1960-1971

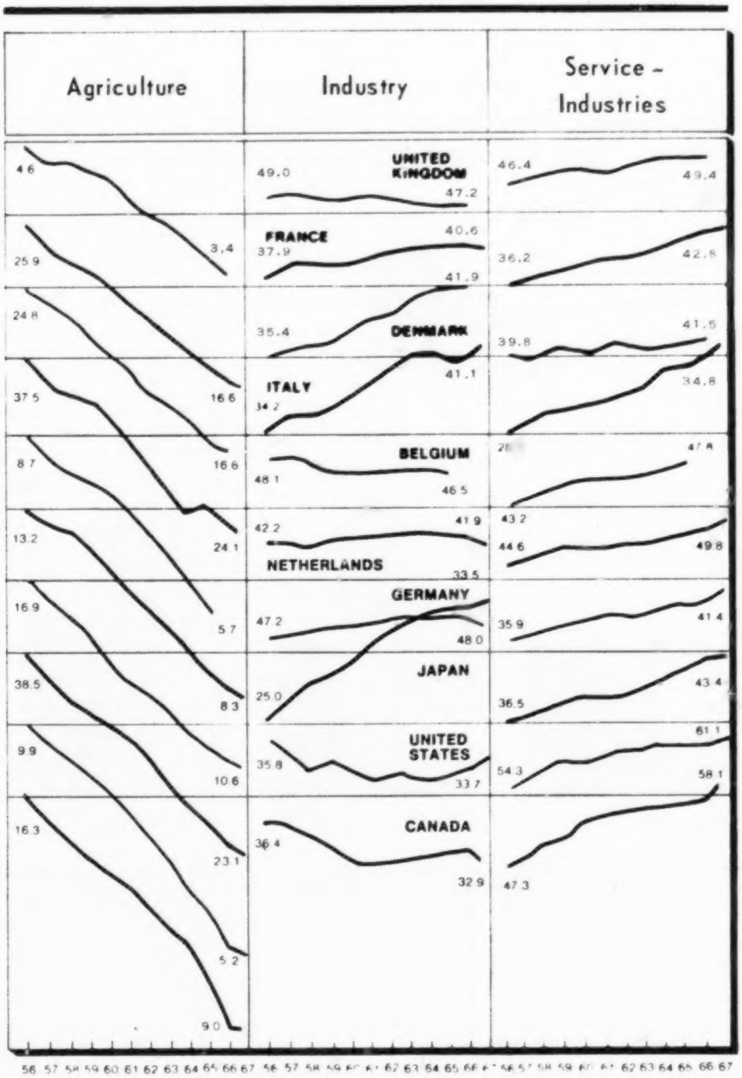
	Total Civilian Employment (thousands)		Primary Sector (Agriculture and mining)		Secondary Sector (Industry)		Tertiary Sector (Services)	
	1960	1971	1960	1971	1960	1971	1960	1971
AUSTRALIA	-	5,314	-	8.6	-	38.9	-	52.5
AUSTRIA	3,239	3,142	24.6	18.3	40.3	41.0	35.1	40.7
BELGIUM	3,447	3,747	8.6	4.8	45.5	44.7	44.9	50.5
CANADA	5,965	7,879	13.3	7.7	33.2	31.4	53.5	60.9
DENMARK	2,150	2,325	21.2	11.4	38.6	38.5	40.2	50.1
FINLAND	2,087	2,142	36.4	22.7	31.9	35.5	31.7	41.8
FRANCE	18,712	20,410	22.4	14.0	39.1	38.9	38.5	47.1
GERMANY	25,954	26,705	14.0	9.0	48.2	50.3	37.8	40.7
GREECE	3,363	(3,352)1	57.0	(48.2)1	18.6	(22.5)1	24.4	(29.3)1
ICELAND	68	79	23.5	19.0	35.3	35.7	42.2	44.3
IRELAND	1,045	1,058	37.3	27.5	23.7	30.0	39.0	42.5
ITALY	20,002	18,774	32.9	19.6	36.9	43.7	30.2	36.7
JAPAN	44,360	50,940	30.2	17.4	28.5	35.7	41.3	46.9
LUXEMBOURG	134	144	15.4	11.1	44.0	46.5	39.6	42.4
NETHERLANDS	4,052	4,567	11.5	7.2	42.3	41.0	46.2	51.8
NORWAY	1,395	1,497	21.5	13.9	35.6	37.3	42.9	48.8
PORTUGAL	3,126	3,030	42.8	33.0	29.5	35.8	27.7	31.2
SPAIN	11,474	12,372	42.3	29.6	32.0	37.4	25.7	33.0
SWEDEN	3,586	3,854	15.0	8.1	42.1	38.4	42.9	53.5
SWITZERLAND	2,468	(2,717)	11.4	(7.0)	50.0	(51.4)	38.6	(41.6)
TURKEY	12,099	(13,519)1	80.5	(72.1)1	10.4	(11.6)1	9.1	(16.3)1
UNITED KINGDOM	24,256	24,709	4.3	2.9	48.8	46.5	46.9	50.6
UNITED STATES	65,778	78,627	8.3	4.4	33.6	(33.3)	58.1	(62.3)

OECD Secretariat Estimate.
Figures for 1960 are calculated from Basic Statistics, Labour Force Statistics, 1957-1968, OECD, Paris 1970, pp. 22-25.
Figures for 1971 taken from The OECD Observer, No. 56, February 1972.

(1) Refer to 1969.

Table 3

CIVILIAN EMPLOYMENT BY SECTOR



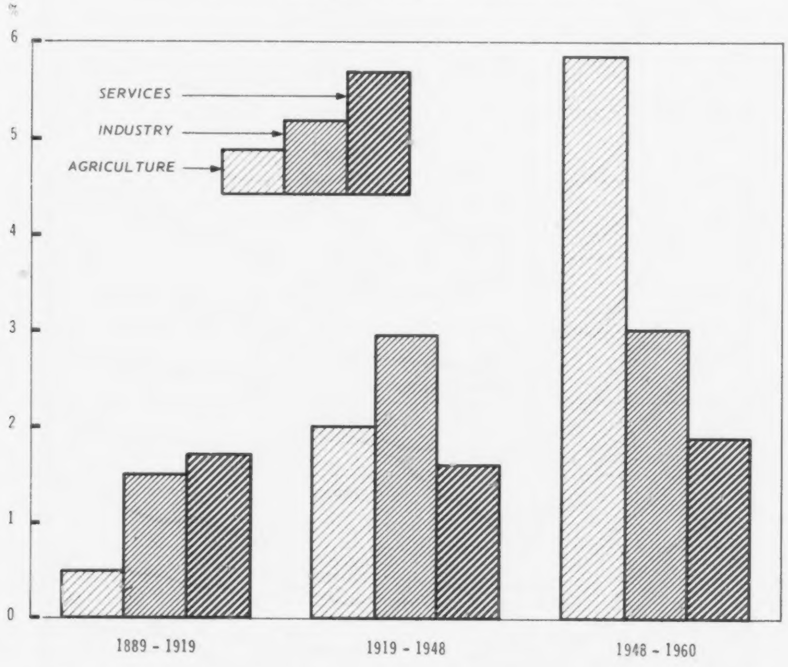
The figures shown on this chart represent percentages on a logarithmic scale

Source : OECD At Work, March 1969, p. 126.

Table 4

OUTPUT PER WEIGHTED MANHOUR

AVERAGE ANNUAL PERCENTAGE RATES OF CHANGE FOR SELECTED PERIODS, US PRIVATE DOMESTIC ECONOMY : MAJOR SECTORS



Source : John W. Kendrick, "Technology and Productivity Trends in the US-Economy, Sectorial Trends and Shifts," in Symposium on Improving Productivity through Technology in the Service Sector of the Economy, National Academy of Engineering, November 1, 1971.

> whereas the growth of man's information has no end in sight - only more growth. Ready access to information together with the means for assimilating it could be considerably assisted by the use of computer/telecommunications systems.

This broad survey of the promises of telecommunications-based computer systems as a resource for improving the capabilities of the service sector might, in addition, reveal some planning parameters which touch upon considerations of the systems themselves. Before they can become a resource for the service sector, they have to prove their capacity to satisfy the needs of large-scale economies. Such prospective economies for the service sector, leading to improved productivity, depend in turn on high levels of traffic. Consequently, the discussions in this chapter should be interpreted as:

- first, suggesting some of the promises which computer/telecommunications technologies hold for the economy, particularly the service sector in this instance; and,
- second, indicating where a critical mass of users might be found to generate the necessary traffic and construct such a network.

3.2 GOVERNMENT

If public planning and governmental operative functions are characterised as being basically "the collection and manipulation of information"*, a major user of computers and telecommunications may well be government, particularly with respect to new ways of co-operation between different units of public administration as well as contacts with the public. These new systems seem not only appropriate for the new role of public administration as a complex service network responding at the right time to shifts in social demand and national priorities, but they also promise more efficient and more economical management of public services.

The following are some of the criteria emphasized in the literature on the subject:

- there is a need for more efficient liaison between employees and data centres of federal and central government; computer/communications systems can provide this;

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* Genscher, H.D., Minister of the Interior, Federal Republic of Germany, in: PK Personenkennzeichen, Heft No. 7, Öffentlichkeitsarbeit des Bundesministeriums, June 1971.

- decision-making processes and the structure of information flow should be improved so that determinations can be made against programmed criteria* within supporting information systems and at prescribed decision levels;
- in certain areas of public services, such as law enforcement, medicine, social security and education, there is need for computer/communications networks to improve the execution of major national programmes.

3.2.1 Expected macro-economic savings in public services

The possible 10% savings, previously mentioned in annual government budget, applies to the qualitative and quantitative improvement in the management of public services. However, they stand for the service sector as a whole and take into account, besides the cost/benefit advantages in the provision of those services, the changed life style and the quality of life of individual citizens.

United States experts in the field have emphasized the enormous impact of these changes in the savings that can be made on the achievement of national goals through better decision-making and policy analysis at the federal government level. The following projections** were presented for illustrative purposes. The United States Government will spend some $ 1.6 trillion in the course of the next ten years for social need projects broken down as follows:

Project	Expenditure in Billions of US $
Agricultural research	2
Highways	50
Mass transit	15
Transportation services	20
Education	300
Health	450

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* This would not only be of help to the executive officer but also to a possible "Ombudsman" dealing with public complaints of bad public service.

** A Technology Assessment Methodology: Computers-Communications Networks, by Hugh V. O'Neill, Washington, June 1971. Prepared by the Mitre Corporation for the Office of Science and Technology, Executive Office of the President, Washington, June 1971, p. 144.

Project	Expenditure in Billions of US $
Welfare	700
Urban redevelopment	60
Water and power	50
Retraining	19

Total: More than $ 1.6 trillion

These experts believe that 10% and more could be saved at least in part through the use of integrated computer/telecommunications systems. If there is a saving of only 10% this could be some $ 160 billion which could be re-allocated to critical areas in these programmes.

Another well-reputed expert agency arrives at similar results and recommends the immediate establishing of such plans for computer/telecommunications networks offering both traditional services (telephone, telex, etc.) and new broadband-consuming telecommunication services. The IED/EIA* predicts savings on public services through the application of such broadband networks in the following field:

Public Service	Most Likely Savings
Domestic Air Travel	over $ 6 billion
Highways	over $ 6 billion
Police protection	over $ 3 billion
Post Office	nearly $ 6 billion
Fire protection	over $ 1 billion
Recreation	over $ 28 billion

3.2.2 Conceptual studies of networks and services

Studies done for California and Nebraska** provide a basis for appraising the extent of the data entry points that will be involved in these computer/telecommunications systems. Table 5 shows the pattern of information flow between federal, state and local governments.

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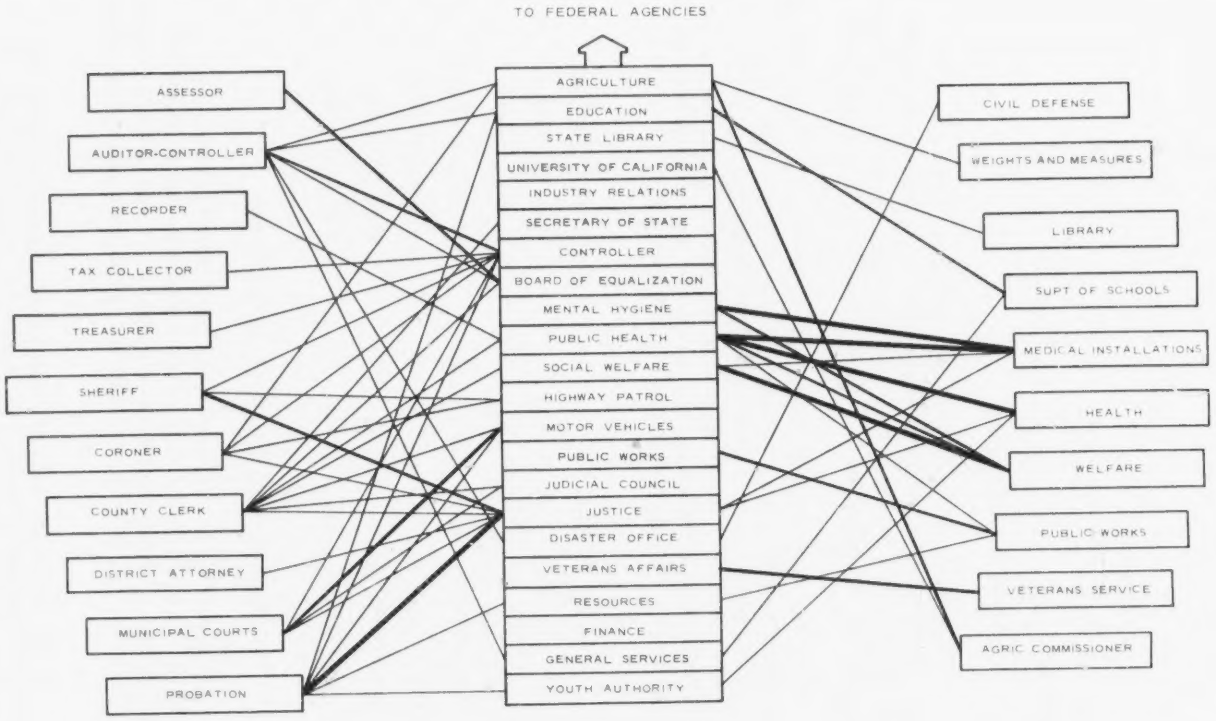
* The IED/EIA Response to the Federal Communications Commision Docket 18397, Part V, The Future of Broadband Communications, submitted to the FCC in October 1969, Industrial Electronics Division, Electronic Industries Association, Washington D.C.

** See Studies of Lockheed Aircraft Corporation for the States of Nebraska and California, 1969.

Table 5

VOLUME OF INFORMATION FLOW BETWEEN STATE AND LOCAL GOVERNMENT



Source : Lockheed Missiles & Space Company, California Statewide Information System Study, Final Report, p. 4-12.

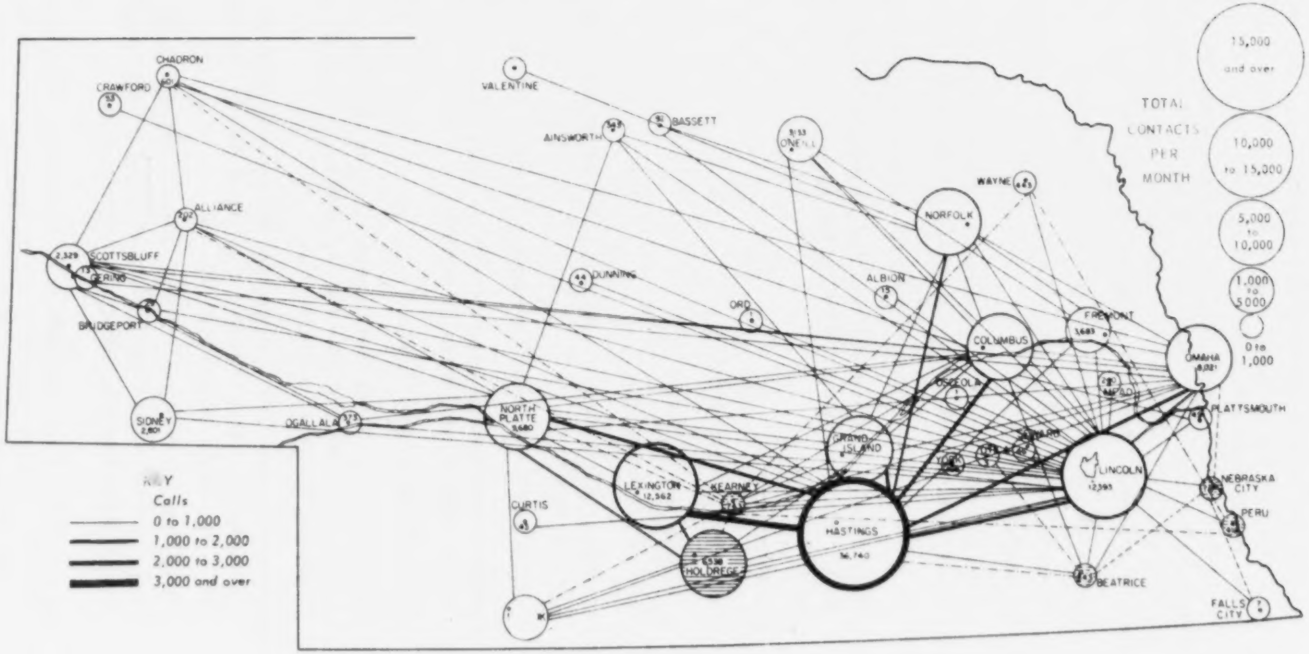
Table 6 shows the range of information exchange, i. e., telecommunication requirements, for example, within the departments of the State of Nebraska. The Studies of the Lockheed Aircraft Corporation make it quite clear that in most cases only time-shared, computer-utility type operations are economically feasible. In addition, these studies show that information exchange requirements include wideband data and image transmission media to provide such services as:

- personal identity data - social security number;
- personal employment data - employers, previous employers, occupation, earnings;
- personal education data - schools, courses, degrees, achievements, numbers and ages of pupils and teachers, etc.
- welfare data - periods of welfare, reasons for aid;
- health data - physical deficiencies, number of hospitals, age of hospitals, number of beds, numbers of doctors and nurses, etc. ;
- tax data;
- voters registration data;
- licences and permits;
- law enforcement data;
- court actions - plaintiff and defendant, court, date, type of action, result;
- probation data - probation number, offence, terms, conditions;
- registered personal property - cars, motorcycles, boats, firearms, dogs, ambulances, elevators;
- vehicle registration files;
- land details - zoning uses, assessed value, taxable value, deeds, water and mineral rights, drainage, soil type, details of buildings, owners, sales, etc.
- owner occupant files - names and addresses, licences, occupation group, place of work, children at school, income group, vehicles owned, police records, etc.
- street section records - name, class of street, length, drainage, limits, intersections, surface, traffic data, parking data, street light, sewers, signals, accidents, etc.

For the quantitative approach (i. e., how often, how much and where to where), two characteristics are of equal importance for the planning of these network requirements:

Table 6

PRESENT POINT-TO-POINT STATE COMMUNICATIONS TRAFFIC
WITHIN 18 DEPARTMENTS OF THE STATE OF NEBRASKA, USA



Source : Fred. Gruenberger, Ed. Computers and Communications - Towards a Computer Utility, p 180.

- the same data may be used by different sectors of society, and;
- one sector may need data coming from different sources.

Both are of equal importance for planning the capacity and flexibility of telecommunication lines along which data are to be transferred.

However, the location of files, and the question of what data are to be stored where will be determined by the balance between data storage and data transmission costs.* In any event the tariffs as well as the performance of telecommunication links will be major factors in government decisions to introduce new services, such as education programmes (computer-aided instruction), as well as general business utilities, which will technologically permit a more equitable distribution of information (and consequently of power). The alternative is to risk exacerbating serious tensions in our society by permitting further widening of the gap between the information-rich and the information-poor.

3.3 REFERENCE SERVICES

The first commercial applications of on-line real-time and time-shared modes of operation of computer/telecommunications systems were those which involved access to a data base by many remotely located users. These early systems were airline or railway reservation and stock market quotation services.

At present, applications are extending rapidly and specialised information networks are being developed for handling such diverse forms of information as police records, credit reports, medical and legal files, and scientific data of all kinds.

These applications, however, will expand more and more as trade-offs among these systems are realised and remote access systems become economically more attractive.

Already airlines are beginning to link passenger seat reservations and freight scheduling systems, and inter-connections are being made, not only between airlines, but also between hotel, car-hire and even entertainment reservation services.

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* This interdependence of possible applications and the balance between data storage and processing costs and transmission tariffs are the subject of Chapter 5.

Some of the broad service categories which might develop similarly are:

- professional services - legal, medical, law enforcement, scientific, engineering, pharmacy, agriculture;
- business - credit, real estate, marketing reports, regulation, prices, trade data;
- consumer - consumer information systems, price comparison; quality comparison,
- general information - political and economic data, historical data, travel, weather, entertainment.

3.4 EDUCATIONAL SERVICES

Of all applications, the computer/telecommunications-based educational services seem to offer the greatest long-term promise. Here the emphasis is on supplying a computer-oriented service to the individual and providing facilities for the further education of professional people-already an important political programme in many OECD countries. More emphatically, some authorities consider these tools a major contribution to overcoming the so-called education crisis which takes the form of a lack of teachers; some cost-performance studies have been undertaken to compare the economics of computer-aided instruction with traditional teaching methods. Kopstein and Seidel, for instance, estimate a cost of 11 cents per student per hour for CAI (computer-administered instruction). The cost of traditional instruction the other hand, is expected to go up from the current level, estimated between 89 cents and $ 1.10 per student per hour in higher education. *

Without going extensively into this complex field, the nature of education suggests four general areas in which the computer utility concept can be of service:

- as an aid to bibliographic and textual retrieval in libraries;
- as an aid to solving problems;
- as a tutor in conveying didactic information;
- as a simulator of situations, with extensive use of visualized graphics, etc.

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* Kopstein, Felix F. and Seidel, R. Computer-administered Instruction versus Traditionally-administered Instruction: Economics, George Washington University, Human Resources Research Office, 1967, pp. 31-67.

Parker is convinced that it would be possible thus to bring up a new social generation. He argues that if people had access to both information and electronic aids to information and information-processing from earliest childhood, the present training and re-training throughout their lifespan might be superfluous and the result could be a more productive society. * What may be ultimately achievable cannot be decided here, nevertheless, it may be safely concluded that these applications of computer/communications systems could contribute significantly to, or even make feasible, the much discussed plans in many OECD countries for permanent education. Consequently, these possible applications should be included in planning computer/telecommunications requirements.

A very important fact is that it is now also possible to have access to analogue-represented data, such as books, newspapers and microfilm, in a time suitable for use from a time-sharing system. Here only the selection and transmission would be under computer control.

The demands made on telephone lines which allow remote dialogue between students and computer can easily be understood from recent developments on the terminal side.

Considerable effort is being expended on developing relatively low-cost graphic terminals whose purchase price now varies from a minimum of $ 2,600 to a maximum of $ 14,000 and whose monthly rentals range from $ 75 to $ 3,700**. One way of bringing prices down lies in the exploitation of widely developed television technology. However, an important difference between ordinary television sets and such a "videographic display" is the latter's memory requirements. Usually each graphic terminal (such as the Rand-Tablet, for instance, on which the student can write and draw figures for display and manipulation) requires its own data store and interface device and is, as a consequence, relatively expensive. ***

An exception may prove to be the Bitzer Console, a plasma display panel with inherent memory which is digitally addressed. The console is a flat sheet (actually a sandwich of two flat sheets of glass in which is imbedded a gas) very small spots of which can be caused to glow through a light-pen; the image is composed of 512 x 512 dots on a ten-inch-square screen. This is the backbone of the CAI System, Plato IV, which Bitzer and his colleagues developed for the University of Illinois. In its final form Plato IV will comprise 4,000 plasma displays tied to a CDC 6,000 and a Burroughs Illiac IV.

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* Parker, W.B., "Information Utilities and Mass Communications", p. 67.

** The Emerging Technology (Rand Corporation), p. 314.

*** Its cost is estimated between $1,000 and $2,000, Ibid., p. 314.

Mass produced, the Bitzer Console promises to bring costs down below $500* and is considered a very significant breakthrough on the way to practical information utilities. Its implication for communication data links can be easily understood if one recalls that commonly used telephone lines offer only a transmission capacity equal to 4kHz. whereas visual displays, such as the videophone, require wideband transmission facilities between 500 and 2,000 kHz. and entertainment TV up to 500,000 kHz.

3.5 FINANCIAL SERVICES

Professional groups increasingly appreciate the advantage for them of the remote access offered by specialized networks. Until now most interest has been shown by the worldof finance. Its representatives were among the first commercial applicants of the on-line real-time and time-shared modes of operation which involved access to a common data base by telephone lines. (This could be considered a micro-economic approach). Bank, insurance company and investment broker have been realising productivity increases through the new technologies with the resultant economies of a data-processing system over their former manually operated services.

At the beginning of real-time computer systems in the banking sector, the teller used "machines" to update customers' accounts. In the Swedish SIBOL project, this idea has been perfected (Table 7). Financial transactions are conducted without cash or cheques, similar to credit card transactions. The customer has simply to identify himself at one of the telecommunication terminals situated anywhere on the service network of the bank. Details of the transaction are keyed into the terminal and sent over communication lines to the computer which stores the record of the payee and payer. The latter's record is debited and the former's credited. The financial transaction is accomplished and a statement mailed by the computer to the customer.

The expectations of such computerised banking systems - equally true of similar applications in such operations as plane and hotel reservations - have recently been published for a French bank which links 25 branches all over France to its CPU in Paris. It shows, clearly, the cost advantages of on-line computing (Table 8). However, most organisations find that the computer does not actually replace manpower, but permits better use of existing staff and efficient handling

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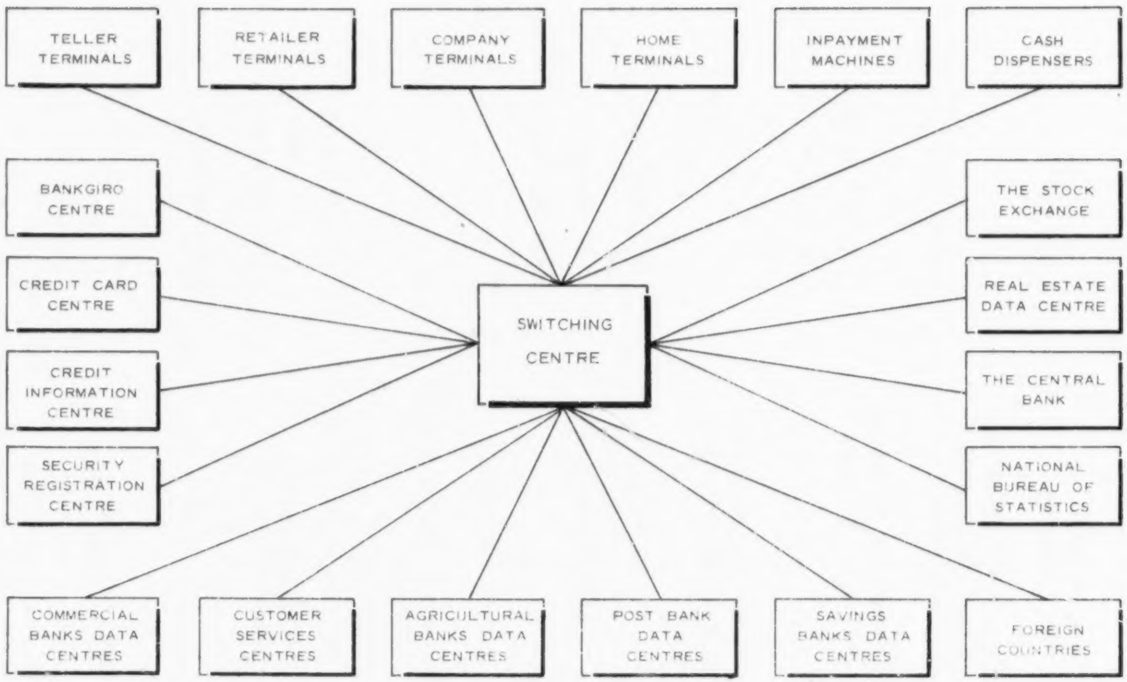
* "Information Systems Applications in Education", by H.F. Silberman and R.T. Filep, in Annual Review of Information Science and Technology, Vol. 3, 1968, p. 382.

Table 7

DIMENSIONS OF A CASHLESS SOCIETY



Source : SIBOL Project (Sweden).

Table 8. A TIME-SHARED SYSTEM FOR ALL BANK BRANCHES

Data Collection (60 employees)	1,500,000 Fr/yr.	
Data transmission costs on the public switched telephone network	1,100,000 Fr/yr.	
Transport of documents by all physical means	450,000 Fr/yr.	
	3,050,000 Fr/yr.	3,050,000 Fr/yr.
+ gross expenditures including amortization costs		
- for 1/0 devices	720,000 Fr/yr.	
- for transmission facilities (modems)	320,000 Fr/yr.	
	1,040,000 Fr/yr.	1,040,000 Fr/yr.
Total overhead costs		4,090,000 Fr/yr.
Savings could be computed as follows:		
Personnel - Office clerks (180 employees)	4,500,000 Fr/yr.	
Desk and machine amortization	1,400,000 Fr/yr.	
	5,900,000 Fr/yr.	5,900,000 Fr/yr.
		-4,090,000 Fr/yr.
Actual savings		1,810,000 Fr/yr.

NOTE : CPU-time, identical in both cases,
is not included in the comparison.

SOURCE: Colloque international sur la téléinformatique, Paris, 1969, Vol. 2, p. 1104.

of the exploding number of transactions. Thus it seems a contradiction that banks in some Member countries are beginning to impose rather high charges on their customers for each transaction.

3.6 MISCELLANEOUS APPLICATIONS

Without going further into the efficiency audit approach to computer/telecommunications systems, one can safely assume immense economic advantages in their use. Unfortunately one cannot yet forecast the ultimate size of the user group.

There is a considerable bottleneck in the field of telecommunications to be overcome by planning parameters for future networks including a wide range of possible applications from both an economic and a societal point of view. (Some were discussed previously as CAI and consumer information systems.)

An enormously potential market for computer power and services, involving appropriate telecommunication, clearly lies in future applications to the needs of:

- small business;
- professionals (doctors, architects, sales agents, etc.) and
- the home.

For the small businessman, such applications could substantially improve his competitive position with regard to the large corporations, because they could provide him with the same sophisticated planning system, market analysis tools, accounting and stock control, and ordering procedures employed by his larger competitors.

Likewise for the professional, time-consuming bookkeeping, accounting and billing functions, which now absorb so much of his time, could be transferred to the computer. The kind of help such real-time systems could provide might be illustrated by the concept that in the creative process 1% is inspiration (or art) and 99% calculation and laborious working-out of detail.

The object of using a real-time system operating as a utility is to eliminate as much as possible of the drudgery and enable the individual to see as quickly as possible the consequences of his ideas. In a process of trial and error, if there are several months involved, the creator may have lost much of his original thinking. If, on the other hand, he can explore the effect of his ideas in real-time, much more fruitful thinking is possible.

Within the home the possible use is similarly unlimited. It ranges from information storage and retrieval, budgeting, bookkeeping and teaching to reception of a newspaper over a CRT (cathode ray tube) screen, possibly equipped with a hard-copy device for receiving letters. Optimistic experts even predict many elements of true participatory democracy through such domestic applications: "beginning with electronic opinion sampling, extending next to electronic vote-taking in local elections and referenda, later to national elections, they could eventually permit everyone to vote directly on all major issues". *

3.7 CONSUMER INFORMATION SYSTEMS

Another promising application of computer/telecommunications systems would be a consumer information system. Some of its characteristics might be described as giving the consumer a possibility to retrieve on visual display units the product he is considering, to compare its price with others in his town and thus decide where, at which shop, and when to buy it.

It is believed that such a system would not only be convenient for the consumer, but also a major instrument to animate competition.

Some experts believe this system would constitute a weapon in the hands of the consumer, enabling him to protect his interests in the face of an economy characterized by mergers and the exclusion of competition on the supply side. In consequence, the telecommunications-based computerized consumer information system could help realize the economic concept of consumer sovereignty.

3.8 TELECOMMUNICATIONS SYSTEMS AND PRINTED MEDIA

3.8.1 General remarks

The economic motivations for introducing new technologies are manifold. The opportunities or market pressures for exploiting cost-reducing processes are generally considered the raison d'être of automation, loosely defined as increasing productivity, i.e., producing goods or offering services with less use of financial and human resources.

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* Parkhill, Douglas, op.cit., p. 53.

Recent developments in telecommunication and peripheral aspects of the information utility concept promise to revolutionize traditional mass-information media such as books, newspapers, magazines, letters, etc., in terms of both production and distribution.

3.8.2 Recent technological developments

The two recent technological developments which will profoundly change written forms of communication are called facsimile and videophone. Both techniques have been thoroughly researched and developed and are now ready for mass production. Both devices have been demonstrated in various places, among them the World Exhibition of 1970 in Japan and more recently in the telecommunications exhibition, "Telecom 1971", in Geneva.

> Facsimile - The difference between the "old" and the "new" facsimile technique is in the time element. Whereas the present system (in the form of a facsimile telegram) requires 15-30 minutes to transmit a document over a telephone line, the "ultra-fast fascimile" needs only 2-3 seconds for the transmission of a document 21 x 29 cm. in size.*
>
> Videophone - This technique allows transmission of both conversations and documents. It promises through various possible combinations, to offer a new special service - video telephony - and an ultra-fast telegram service. This difference from "facsimile" is important: as an independent service, the videophone operates in real-time, which means that it needs 1/25 of a second to transmit voice and image. This has an important impact on the communications network: 100 to 500** conventional telephone lines will be needed to allow communications between two remote users.

However, the use of videophones to transmit all kinds of documents opens up exciting application prospects. The economies of transmitting any kind of written information arise from the fact that it is not necessary to code this information, as distinct from the telex system, for example, which necessitates at least two steps.

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* FITCE Report: Fernmeldewesen - Weiterentwicklung und Forschung; Prospektive Studie für den Zeithorizont 1985, Nov. 1969, p. 28; Plan et prospectives, Commissariat général du Plan, Postes et Télécommunications, Paris, 1970, p. 38.

** Varying with the size of the video screen and the quality of the transmitted image. See FITCE Report, p. 28.

FITCE: Federation of Academic Telecommunication Engineers of the European Economic Community.

To use the videophone as an ultra-fast image application would be a derived service, because only "standing" pictures are transmitted. However, in abandoning the requirements for transmitting a moving picture, all kinds of compromises between technical transmission characteristics and time of transmission are possible.

With respect to possible applications of facsimiles and videophones, two merit special mention for both economic and political reasons: the "electronic newspaper" and some of the traditional postal services, such as letters, printed matter, postal and money orders, COD, etc.

3.8.3 The electronic newspaper

The production and distribution of newspapers is a remarkable application of telecommunication-based computer systems which has already gained considerable ground.* Table 9 illustrates the possible consequences, both in the editing and distribution. In the former, incoming news, reports and articles by correspondents located all over the globe are introduced into the computer utility; editing is done on a device somewhat similar to a TV screen by means of light points or electronic correction instruments.

Distribution of the electronic newspaper is even more fascinating. The individual reader chooses via communication links whichever newspaper he likes. During the World Exhibition of 1970 in Japan, the "Asahi"** and the "New York Times" were transmitted by facsimile. It is estimated that - mass-produced - the terminal would cost between $ 50 and $ 100.***

Similar distribution - but without hard copy - of a newspaper was recently presented by Matsushita Electrical Industries, making it possible to receive a newspaper over video and sound channels on the TV screen in individual homes.

The challenge of such a "telenewspaper" may be summarized as follows:

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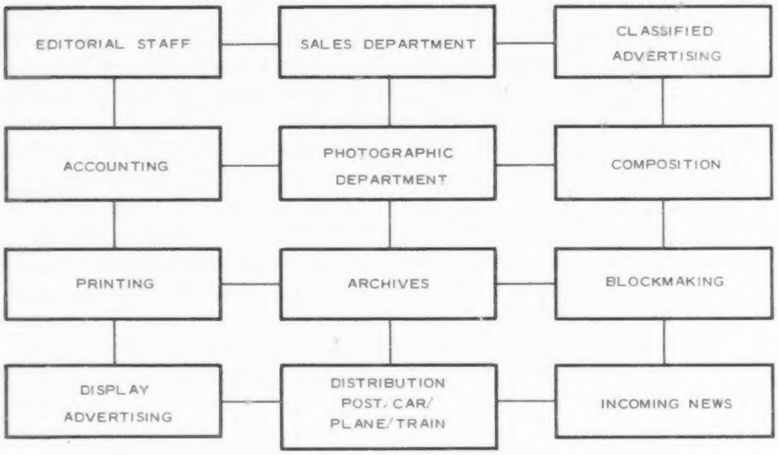
* On the production side, Pravda is applying an ultra-fast facsimile system: the belinogramme: Pravda is printed simultaneously in Moscow and Kabarovsk, 8,000 km. apart, via the satellite Molnia I.

** The Asahi was received through Toschiba Tele-newspaper receiver AT3. This prototype works on electrostatic recording with multistylus electrodes; size of the hard-copy: 32 x 45 cm; frequency bandwidth: 240 kHz; transmission time: 5 min, 10 sec. for both sides of a page.

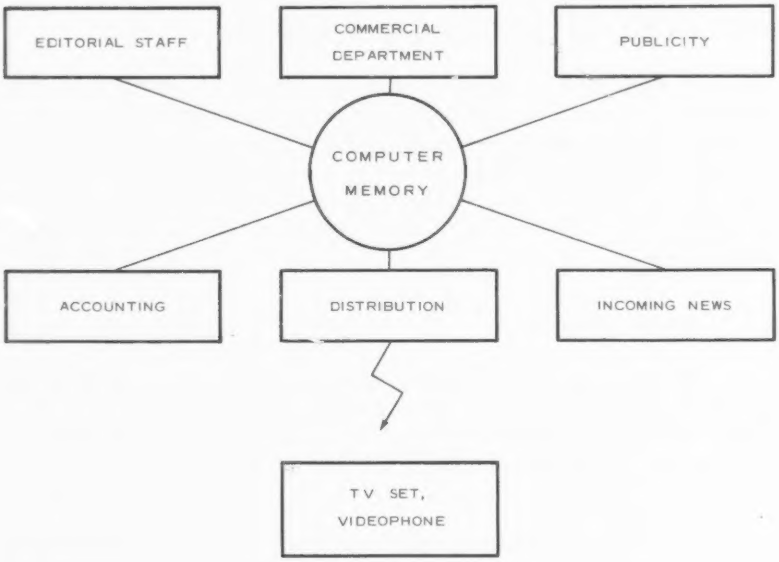
*** Private communication from the manufacturer.

Table 9

ORGANISATION OF A CONVENTIONAL NEWSPAPER/PUBLISHING CONCERN



INTEGRATED PUBLISHING CONCERN - THE ELECTRONIC NEWSPAPER



- the information is distributed virtually immediately. (Today almost all newspapers refer to events which have occurred 12 hours earlier). *
- the dissemination of information through the present media, such as newspapers and magazines, could be done more efficiently in terms of fresher information and cheaper distribution. At present the powerful publishers' lobby has succeeded in labelling the distribution of newspapers and magazines as a public service. Thus the price of the distribution of printed matter often covers only 33% of its actual cost and consequently causes deficits of many hundreds of millions of dollars. Since the Post Offices are not reimbursed, they lose financial resources urgently needed for the introduction of new technologies within the telecommunication services. In some OECD countries these very political services prevent post offices, particularly those offering both postal and telecommunication services, from coping with new technologies for lack of financial resources.

Since the computer-utility could make the printing of newspapers à la Gutenberg obsolete, it seems feasible for newspaper publishing groups to produce and distribute daily information independently of the printer and printing press. Basic costs for publishing the average good newspaper break down as follows: editing (staff) about 20% and printing (press and paper) approximately 80%. A computer utility shared among publishers would significantly reduce the latter cost.

It would be worthwhile to study the application of the computer utility as a means of arresting the concentration process occurring currently in some Member countries and stimulating competition within the vital information medium which the press represents as well as guaranteeing a wider range of information from different sources, as might be required by the constitution or the political system of many members.

3.8.4 Postal services

As it is beyond the scope of this report to discuss in detail the impact of these technologies on traditional postal services, such as transportation and distribution of letters; printed matter and newspaper, only certain points will be made.

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* In addition, the "telenewspaper" would no longer be subject to printing and distribution times, which in turn are subject to transportation and weather conditions, but to the capability of the journalist to transform his knowledge into an article.

In recent years it has been proved that the telephone cannot be considered as a competitor for written communication. It must be emphasized, however, that this statement does not include price-cost competition*, but rather legal factors: a telephone conversation, especially in the business world, generally requires written confirmation; telephone agreements may not legally have the same binding character.

The videophone-telegram service described earlier - both as a single service and as a sub-group of the information utility - fulfils both requirements.

The speed plus the economies of such a service could easily turn it into a competitor for certain mail service, and calculations may support this argument. The commercial costs of transmitting a page 21 x 29.7 cm. in size are estimated as :

- $ 0.003 for within-city area mail delivery,
- $ 0.015 for distances up to 500 km.**

The attraction of such a telecommunication-based postal service is evident, if the above-mentioned tariffs are compared with present surface-mail rates for a letter to arrive at its destination within 24 hours: $ 0.08***, i.e. some 5 to 26 times more expensive.

Since the front-end-device (the videophone) would be expensive in the beginning****, only industry and professionals might afford to install and use these video-telegram-terminals. FITCE experts therefore recommend the installation of the device next to post offices and traditional letter boxes, so that the service can be used by anyone.

Incentives and parameters for planning such a service also involve the fact that,

- the time of traditional mail delivery is becoming increasingly a matter of public criticism;
- the above-mentioned surface-mail tariffs are themselves only planning parameters, since they are steadily increasing;

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* FITCE Report, p. 28. Private information from P. Bernhard, FITCE, July 1971.

** FITCE Report, p. 51. Private information from Mr. P. Bernhard, FITCE, July 1971.

*** FITCE Report, p. 51.

**** A study by the Centre national d'études des télécommunications has estimated these costs of videophony:

$ 800 - installation costs
$ 100 - monthly rental fees (or purchase price, $ 2,000)

SOURCE: Plan et prospectives, p. 36.

- the deficit in traditional mail service could itself be a major planning parameter for the innovation process: it seems that letter mail, printed matter delivered, money order and second-class/newspaper services make up the bulk of postal losses in most OECD countries. *

3.9 TELECOMMUNICATIONS AND THE DECENTRALIZATION ISSUE

There is one remarkable fact about electronic communications in the sense of message (information) and physical transportation: they cannot be substituted for one another, but rather encourage each other mutually.

The first industrial revolution increased productivity through the economies of large-scale operations. The basic concept was centralization in terms of both production and location. Transportation constraints and lack of geographical choices favoured this development. The "bigger" the entity, the more efficient the facilities and institutions of government, law, education and public transportation. This has certainly been true up to a point - that of a community's optimal size (similar in economic theory to the optimal size of a company). That point seems now to have been passed and has become the common problem of "urban pressure". Since institutions in the service sector are concerned with data, figures, money, and "information", they locate in (and grow in) their "natural" environment.

Thus shopping centres, administration offices, educational institutions and libraries are found close together, primarily because of mutual interests and the need to communicate. However, the "externalities", including the cost of growth, impinge: the price per square foot in urban concentrations, for example, is rising astronomically, the flow of traffic has become glacier-like. **

The new computer-telecommunication technologies - videophone, switched-conferences, etc. - may not bring about the dispersal of these institutions in their entirety, but they will encourage wider dispersal of many of the units composing them.

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* In the United States, for example, the United States Post Office has, since 1925, made a profit only in the three war years 1943-45. The deficit reported for 1968 for 2nd and 3rd class mail alone (newspapers, printed papers) came to $835,995,484. See J. Keith Horsefield, British and American Postal Services in Public Enterprise, Ed. R. Turvey, 1970, p.287. See also Annual Report of the Postmaster-General, Post Office Department, Washington D.C., 1969, p. 244.

** In Paris, the average traffic flow of a working day declined from 15km. per hour in 1915 to 10 km. per hour in 1970. The "opportunity costs" for personal transportation of civil employees, expressed in working hours lost were estimated for 1970 at something like 700 million francs. SOURCE: PRTF-TV programme on "Costs of Urbanization", 1970.

It is quite possible that there could be a new working pattern: rather than face the rigours of commuting every morning and evening, white-collar workers might work near or even in their homes, using computers, telephones, telex-terminals, facsimile equipment, television, videophones, teletype and other equipment which allow them to interact simultaneously with other people and machines as easily as if they were physically in the same room. The cost "spin-off" between expensive offices and equipment and tele-communication-supported devices could be encouraged if companies were to rent these systems to employees as suggested by Colin Cherry. *

Telecommunications as a substitute, or an additional choice, for physical transportation was recently demonstrated when the treaty between the United States and Japan concerning Okinawa was signed. The Americans and the Japanese linked by satellite communications**, signed the agreement simultaneously in Washington and Tokyo.

* Colin Cherry, Electronic Communication, p. 773.

** Tribune de Genève, 17th June 1971.

Chapter 4

THE COMPUTER UTILITY AND THE DANGER OF MANIPULATION

Earlier in this report the necessity for a balanced approach to the computer utility was mentioned. This means anticipating the social consequences of misdirected telecommunications/computer systems. Information utilities, promising so much, have at the same time magnified the power of manipulation by both governments and private organisations to an unprecedented degree.

Here we might best concentrate on what may be called "economic privacy".*

Such privacy of the individual exists insofar as industry does not instantly know what goods, at what price and in which region, are requested at a given time. The individual consumer pattern might similarly be considered a sphere of individual privacy. With the new computerised banking systems (such as the SIBOL project of a cashless or chequeless society) and other business applications, the evaluation of this economic privacy - i.e. the instant x-raying of the individual-consumer pattern - becomes infinitely easier. Thus the new technologies could favour concentration of economic power, entailing excessive prices, collusive dealing and indifference to public concern over product safety and pollution (assuming that there were no counteracting systems, such as an effective consumer information system of reinforced competitive power of small and medium-sized firms).

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* For excellent contributions to the problems of privacy see: U. Thomas, Computerised Data Banks in Public Administration; G.B.F. Niblett, Digital Information and the Privacy Problem, OECD, Paris 1971, Russell Pipe, Toward Central Government Computer Policies, OECD, Paris (OECD Informatics Studies, Nos 1, 2, 1971 and 5, 1973).

At this point the question of systems costs arises. These costs will determine how fast and in how balanced a way, in the sense defined above, the computer utility will proliferate. They will be the strategic factors which will ultimately decide whether the capabilities of the systems are to be exploited for the benefit of the widest possible sections of society or for only a few privileged sectors, indifferent to prices. It is the issue of equality of opportunities for all individuals to have access to information which is at stake.

Chapter 5

INTERDEPENDENCE OF COMPUTERS AND TELECOMMUNICATIONS

In elaborating policy issues aimed at realising the promises of unbiased telecommunication-based computer systems, i.e., proliferating their capabilities to the widest possible range of individuals, a number of basic considerations should be borne in mind. These include:

- technical interdependence;
- economic interdependence;
- institutional interdependence.

5.1 TECHNICAL INTERDEPENDENCE OF COMPUTERS AND TELECOMMUNICATIONS

Earlier in this report an on-line computer/telecommunication configuration was defined as the merger of the previously disparate technologies of digital computers and telecommunications (primarily the switched telephone network). Since these systems depend entirely upon data transmission lines, the normal boundaries between data-processing and communications are becoming blurred. Without going into technical details, one might consider the main characteristics of the two elements.

a) Telephone network characteristics

To begin with, it might be recalled that the basic design of the existing communication network goes back thirty or forty years* and was exclusively tailored for the transmission of the human voice. For telephony the human voice is translated into electrical oscillations equivalent to its frequencies. (For the understanding of speech and recognition of the speaker the frequency of 300-3,400 Hz* per second was found sufficient.) Consequently, the existing network** is designed to transmit only a frequency range of 300-3,400 Hz in analogue wave forms.

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* McKay, K.G., "The Network", 1968, p. 45.

b) Digital computer characteristics

Distinct from the existing telephone network, which transmits analogue-represented signals in wave form, the digital computer "works" on binary coded strings of bits.

c) Combination of two different techniques

To introduce a computer system into the switched public network is to couple two different techniques and two different user characteristics.

As stated before, the public network operates on the basis of an analogue wave system and is not capable of transmitting digitally represented data (consisting of strings of symbols, usually letters, figures or marks) which come directly from the computer.

At present this weakness is overcome by the use of so-called modems, i.e., modulator-demodulator devices. In a public switched telephone network it operates as follows:

The starting point of any connection is a terminal (telex, typewriter, display unit, etc.) including a modulator-demodulator which adapts the digital signal for the analogue network. The signal then passes to the switching centre, where the recipient circuit is selected. Typically, for a long-distance call the signal will pass through several intermediate switching centres where the long-haul transmission (trunk-line) circuits are interconnected. For efficient long-haul transmission, the signal is combined with others (telephone frequency multiplexing) and passes through repeaters which increase its power to compensate for electrical energy lost along the transmission path. Finally, the signal undergoes a reverse process of de-multiplexing, switching and demodulation in the recipient's terminal, thus from analogue back again into digital form, so that it can be received on another terminal.

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* Hz = cycles per second, as measured in honour of Hertz, i.e. hertzian waves.

** A network includes circuits (lines) for transmitting the electric signal and switching centres for selecting a path for the signal to follow from the many possible combinations of circuits.

The negative costs which use of the existing telephone network imposes on telecommunication-based computer systems, in addition to crucial tariff costs, are:

- the need for costly modems;
- the high rates of error arising from losses and compensations common to the transmission of analogue wave forms*; these rates of error take the form of cross talks, data dropout, etc. They may be due, for instance, to the "noises" caused by the electromechanical switching relays;
- low transmission speeds, compared to the data flow rates of which the central processing unit is capable;
- saturation of the existing telephone network whose overloading is already the subject of complaint during the peak hours (in many Member countries, 09.00 to 12.00 and 14.00 to 16.00).

There are two important negative factors with respect to swift proliferation of raw computer power, new communication services and new information services:

- the existing telephone network;
- the current tariff structure.

d) Adequacy of the telecommunications network

Historically, national telecommunications networks have been geared to the needs of telegraph and telephone customers. Accordingly, the existing network is designed to carry textual or record-coded information and the human voice. Record or textual information is primarily transmitted by means of teletypewriter equipment, which requires channels with frequency bandwidths of less than 300 Hertz. To provide adequate voice transmission channels the telephone network was designed for technical and economic reasons with a bandwidth of 300-3,400 Hertz.

For efficiency in long-haul transmission, voice and subvoice channels are gathered by means of frequency division multiplexing into various groups. For example, twelve voice channels are consolidated into a "carrier group", 60 voice channels into a "super group" and 240 into a "master group".

Because of the limited number of basic channel sizes which can be acquired, the customer frequently has to purchase bandwidth capacity well in excess of his actual requirements. **

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* The human ear can understand or fill in what is missing due to noises on the line; the computer cannot: it becomes "confused".

** FCC Docket 18920, October 1970, p. 133.

Thus a user of an interactive computer/telecommunication system may need a certain line capacity and will find that the common carrier link available is "too small" or "too big" and thus too costly. In other words, he might use a channel capacity of low speed for a "small" request from the system, for example 600 bits, which a telephone line can provide. But to "work" with the answer, as on a CRT display, a large capacity telecommunication link would be required, allowing for instance, the transmission of 37,800 bits per second. This capacity would correspond to some 63 parallel operating telephone lines. At present he has no option but to purchase a 120 telephone-line group, i.e., two "super groups".

The following calculation may demonstrate the need for flexibility in telecommunication line capacity:

The visual display units now increasingly used as man/machine interface are often designed to display both alphanumeric letters and figures and analogue data for graphic information. Thus the screen allows visualization of graphically represented information and line drawings. Some of the CRT displays even allow some coded input by a light pen. To fill the screen, which can, for example, hold 1,200 alphanumeric characters, would require using a six bit code, some 9,600 bits per second telecommunication link capacity, or even more, because of error checking.*

Using a current voice channel and the modem device provided by the common carrier (which allows a transfer rate of 1,200 bits per second), some eight seconds are necessary. If a leased link is efficiently organised, only four seconds transmission time is needed to fill the screen with the text.

To fill the same screen for line-drawings on the same leased line takes some four and one half minutes, given a terminal with memory for regenerating the transmitted bits "to hold the picture on the screen".** This application, which really earns the term "interactive real-time system", ideally needs a reaction time compatible with human manipulative skills and thought. There is not doubt that four and one half minutes "waiting time" before continuing another operation on the screen is too long. If two seconds could be accepted as tolerable, some 133 parallel switched leased lines, each with a transfer rate of 2,400 bits per second, would be required. If every user had, in theory, access to these high-power lines, one would have to purchase a 240-channel voice-grade master group, because existing techniques do not allow the dividing of channels.

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* Martin, James, Telecommunications and the Computer, 1969, p. 60.

** As the screen is made up over a matrix of 800 by 800 dots, the image to be set up needs some 640,000 bits. Thus the response time is calculated, using a 2,400 bit per second line as follows: $\frac{640,000}{2,400}$ = 4 1/2 minutes (approximately).

When the need for data communication arose in the 1960s these classical techniques were simply adapted to enable the transmission of digitally represented data, that is, the strings of binary digits into which the information is coded. The bandwidth of the channels, the design of the switching equipment and therefore the maximum data transfer rates measured in bits per second remained unchanged. Thus the network available does not match the bandwidth required by the large variety of electronic transmission devices, ranking from the slow teletypewriters to the high-speed magnetic tape drives.

Table 10 demonstrates the possible data transfer rates on the computer terminal side which compare with the 1200 bits per second transmission rate generally available on telephone networks.

A recent American market study* has pointed out that most users recognise the potential value of advanced data communication systems. Among the more prevalent complaints found were:

- disappointment with established common carrier data transmission services arising from insensitivity to customer needs, and lack of knowledge of the economic segments and their typical application.
- poor facilities performance; users frequently encountered unacceptably high incidence of circuit unavailability and disconnection, inconsistent transmission, speed and quality, and high incidence of data set and circuit down times.

Thus users seem to have achieved less benefit than they expected from existing telecommunications-based computer applications. According to the Datran Study** - to compensate for the deficiencies of common carriers most users had:

- installed excess facilities (at sharply increased cost) for fallback;
- operated facilities at slower than rated speed:
  a) more than 85% of data sets connected to switched-telephone networks transmit at 30% or less of circuit capacity;

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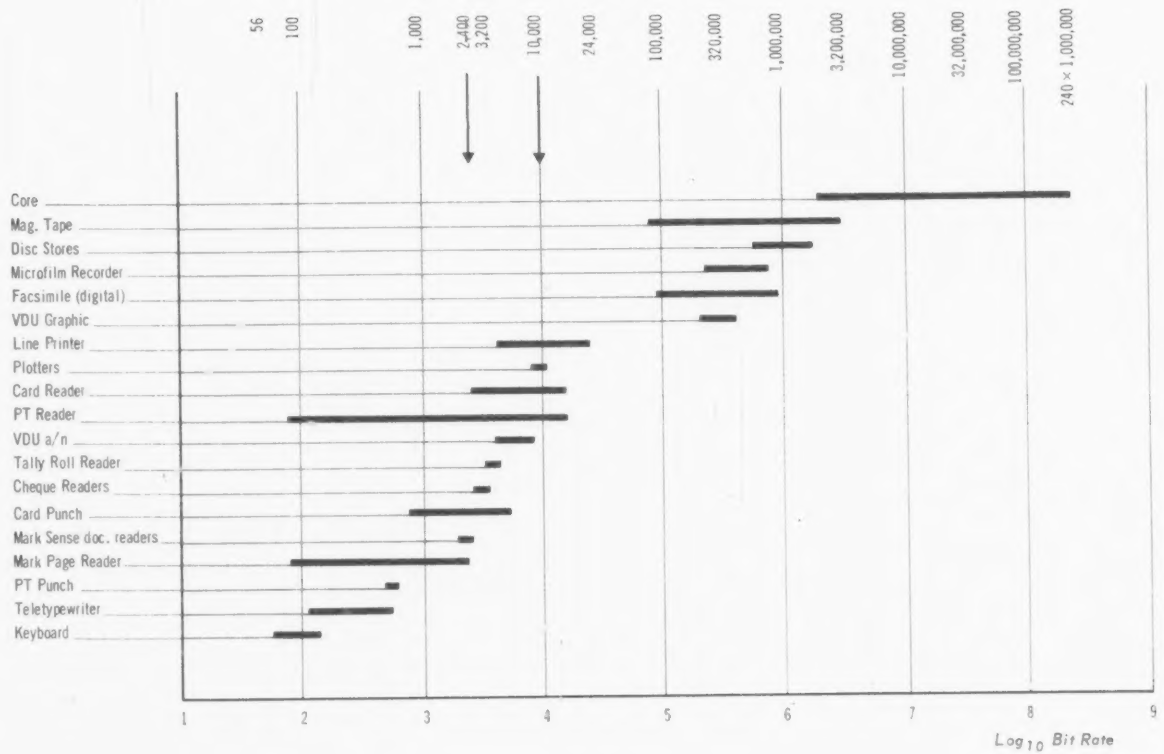
* The data transmission market of the 1970s, Datran Report. Excerpt form a major market research study conducted for Data Transmission Company, p. 26.

** Ibid., p. 24.

Table 10

BASIC "MECHANISM" DATA RATES



b) about two thirds of these data sets operate at less than 15% of circuit capacity;

- designed and installed costly error detection and correction systems and equipment.

Thus, the FCC has concluded: "The inherent inadequacies and inefficiency of transmitting data communications over the voice frequency network of the telephone companies is, at best, a bad second choice - one which can be adopted only by minor portions of the total of potential users - in the absence of specially designed, customized channels which adequately meet the quality, quantity and bandwidth characteristics required by these data users". *

5.2 "ECONOMIC" INTERDEPENDENCE: COMPUTER/ TELECOMMUNICATIONS COSTS

a) Introduction

Besides the technical deficiencies of the existing telephone network for data transmission and thus for the proliferation of the computer utility concept, the tariffs for data transmission do not seem to be responsive or equal to the characteristics of the new telecommunications services. Irwin even considers them prohibitive for most telecommunication-supported computer applications. The tariffs of common carriers in force at present, since they are designed for human voice communication, are not responsive to remote data-transmission needs which, for example, are distinquished by very long holding times (duration of calls), which may last for hours instead of minutes. **

Consequently, data communications users would like to see current time and distance tariffs replaced by tariffs based on the amount of information, i.e., bits, transmitted*** or, alternatively, current connection times (the actual call set up times between two points are in the order of 14 to 22 seconds) and minimum holding times - reduced to milliseconds and seconds respectively.

As a result of the technical deficiencies and pricing philosophy of the telecommunications network, some negative trends are becoming evident, throwing doubt on the economic viability of the computer utility. Unfortunately, since many considerations (such as desired terminal equipment, required bandwidth, distance of the remotely sited user, expected usage, mode of operation and myriad applications) are involved in determining system costs, it is impossible at present to establish a typical cost-performance calculation. However, it seems possible to identify certain trends within the present structure of system costs.

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* FCC Docket No. 18920, p. 135.

** Typical "values" for the duration of telephone calls and thus for establishing rates are: residential calls - five minutes; business calls - three minutes.

*** As applied by INFOCOM (Information Communication Service) and SICOM (Securities Industry Communication System) of Western Union.

b) Trends in data processing costs

Depending on the components, telecommunication/computer system costs might be expressed as the sum of three major elements

- costs of CPU and storage devices;
- costs of terminals and modems;
- tariffs for data transmission and switching.

The costs of these three utility elements have followed quite different trends:

The computer and terminal industries, operating in a highly competitive environment, have realised massive gains in productivity due to rapid technological changes. Consequently, "the cost of raw computing power has declined by an order of magnitude every four years and this trend looks like it will hold for a while". *

On the other hand, most observations about computer time available at present strongly support capacity-sharing of computer systems. For example, the American Department of Defense, accounting for nearly 87% of all government computers, reports that only 50-60% of the computer time of its equipment is used. ** Similarly the computer-time wastage in private applications of time-sharing systems has been quantified as high as 90%. ***

It may be concluded that there is a vital opportunity to share this surplus capacity through appropriate telecommunication facilities.

c) Trends in telecommunication tariffs

Communication tariffs have not followed the trends of CPU costs. Tables 11 and 12 provide a survey of national tariffs for telecommunication services. They also may provide some idea as to which countries

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* Armer, Paul, The Individual, His Privacy, Self-image, and Obsolescence. The Management of Information and Knowledge, p. 75.

** EDP Weekly, 24th May 1971, p. 7.

*** McKinsey and Co. Inc., Getting the Most Out of Your Computer, 1963.

Table 11

3 MINUTE TELEPHONE CALLS, NATIONAL TARIFFS, DEC. 1972

Calls Placed During Working Hours

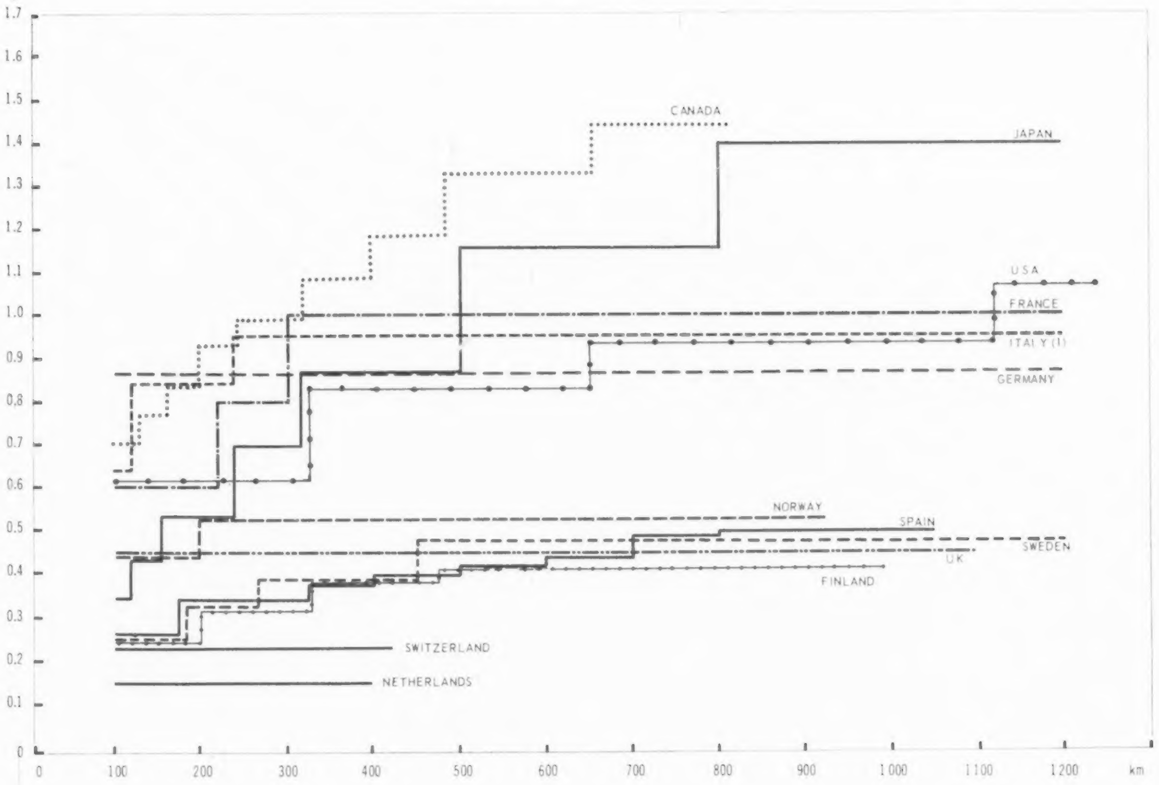
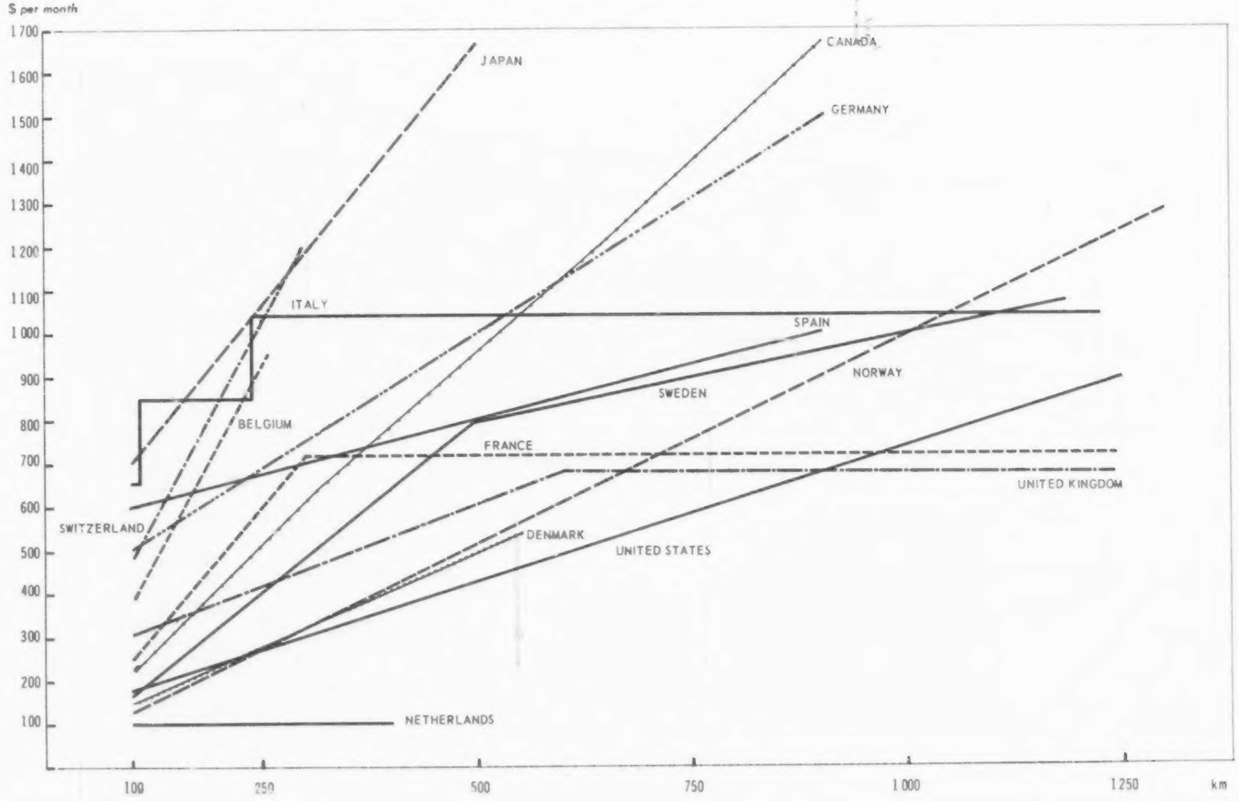


Table 12

LEASED TELEPHONE LINES (CIRCUITS)
NATIONAL TARIFFS, DEC. 1972



offer the best climate for widespread use of computer utilities and thus the most favourable realization of its promises.

With respect to telecommunication cost decreases to be transferred to the user, only the United States and Sweden may be cited; other countries, such as Germany, France or the United Kingdom, are increasing their tariffs or intend to do so in the near future.* For the 1970s, telecommunication cost decreases are now being discussed only in the United States and Canada. The Standford Research Institute estimates United States tariff reductions in the range of 2% per annum.** Canadians may enjoy telecommunication cost decreases of 1.9%.

Consequently, because computer costs are decreasing faster (50% every two years) than communication tariffs (2% per year) the latter become an increasingly significant factor in large telecommunication computer systems. In fact, some present systems already divide costs equally between communications and data processing.*** For one interactive banking computer system in Germany, total communication costs already represent 75% of the total system costs.****

As a result, fears have been expressed that the costs of telecommunication services may prove to be the limiting factor in the future growth of the industry, as an FCC inquiry has found*****, and thus the strategic parameter deciding what services will be computerized and which groups of society will enjoy the tangible as well as intangible benefits of these systems.

Table 13 is presented to help visualize the previously discussed trends in computer hardware costs and telecommunications tariffs.

The solution could be in a nation-wide or supranational telecommunication-based computer information retrieval system made up of one large systems configuration or any number of such systems:

The balance between sharing central processing and storage capacity on the one hand and communication tariffs and terminal charges

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* Germany increased its telephone tariffs on 1st July 1971 and another increase is expected during 1972.

France is increasing telecommunication rates by 17% in 1972.

The United Kingdom increased its telecommunication rates in 1972.

** Zeidler, H.M. et, al., SRI Report No, 7379-4.

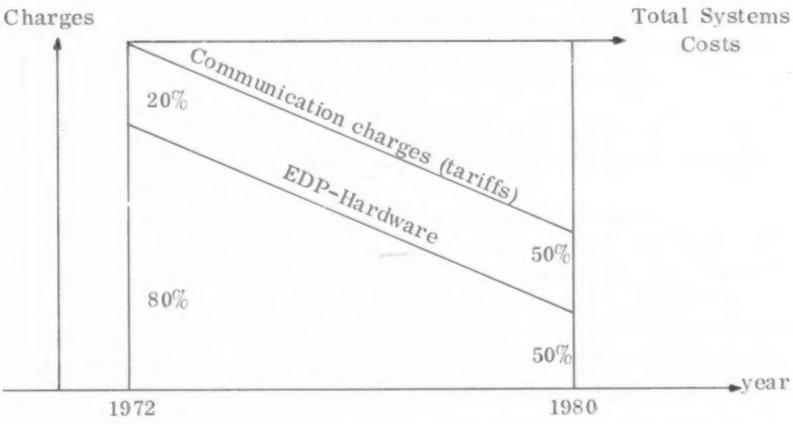
*** Irwin, Manley, in Ed. Gruenberger, op. cit., p. 203.

**** Private communication from Professor M. Gumin, Member of the Board of Siemens A.G., Munich, Germany, July 1971.

***** Federal Communication Commission, 66-1004-90954. In the matter of Regulatory and Policy Problems presented by the Interdependence of Computers and Communications Services and Facilities. Docket No. 16976, 10th November 1966.

Table 13. RELATIONSHIP OF COMPUTER AND TELECOMMUNICATION CHARGES[1]

(in terms of relative shares)



[1] It should be kept in mind that this chart reflects only computer hardware and telecommunications tariffs, not other operational costs such as systems work or software.

on the other necessarily determines how many single systems will have to be built to allow a regional, nation-wide or supranational service. In other words: the sharing of computer and storage capacity is economically attractive only if terminal charges and communication costs do not exceed the cost of duplicating CPU and storage capacity. With existing tariffs in the United States there is some evidence that, for distances exceeding 75-100 miles, central public capacity-sharing systems may not be able to compete with free standing computers. *

Therefore, because of break-even points determined among other things by distance and applied telecommunication rates, such a service "covering" 10 million requests for example, might need 1 or 1,000 computer systems. If such a system were estimated to have a capital value of $ 1,000,000, the cost per request could be $ 100. It is, however, quite conceivable that communication tariffs could become independent of distance through the tantalizing promises of new communication technologies, such as satellites. Thus the same service could be provided with one super machine that costs almost the same amount as for one of the systems mentioned above and provides the same service for perhaps 10 cents per request.

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* Manley R. Irwin, "Federal Regulations and Monopoly" in Computers and Communications, Fred Gruenberger, ed., p. 203.

5.3 INSTITUTIONAL INTERDEPENDENCE

Whatever over-simplification the preceding calculation may contain the fact remains that due to productivity increases and a highly competitive environment, the EDP segment of the telecommunication/ computer-concept is experiencing rapid technological change and considerable cost decreases. In contrast, the telecommunication segment, which is really the vehicle for the resource-sharing concept, is characterised by slow innovation and the absence of tariff reductions although, as the following chapter will discuss, considerable technological progress has occurred in the laboratories.

As a consequence, communication tariffs may become the dominant limiting economic factor in computer utilities and thus the strategic variable affecting the speed of their development and the shape of the entire industry. Therefore, the growth rate of teleprocessing and the quantitative and qualitative economies through its application in the service sector will depend on the rate at which new telecommunication services are offered and telecommunication tariffs decrease. Thus, the governmental administrations which operate telecommunications as a monopoly and the governmental agencies which have to ensure that the franchised common carriers respond in good time to users' needs, both face a tremendous responsibility. It is evident that the effective application of the computer art to meet individual, commercial, scientific and governmental requirements is becoming ever more dependent upon the availability of adequate telecommunication facilities at reasonable cost (the infrastructure approach).

Furthermore, since these technologies are still at an initial stage of growth, governments have a unique opportunity of guiding a key industry in the desired direction (the key-industry approach).

Chapter 6

TECHNOLOGICAL DEVELOPMENT

6.1 ADVANCES IN COMPUTER TECHNOLOGY

In the previous chapter an attempt was made to give an idea of the adequacy of existing telecommunication facilities and services and the terms and conditions under which they are offered by the telecommunication common carriers. There seems to be general agreement that they do not meet present or foreseeable telecommunication requirement from the standpoint of computer technology and its potentials. In addition, the information available shows that there is wide agreement on the necessity for new telecommunication facilities. Thus the assesment of prospective technological developments in the various segments of computer technology, such as mini-computers, video-recording devices, terminals and telecommunication technology itself, becomes of crucial importance for the planning of appropriate networks.

It might be remarked first of all that the growth of electronic computer technology is rapidly outdistancing that of any other technology. This is true in terms of both numbers of systems already installed and their technical performance. New or improved hardware often appears on the market during the still viable economic life-cycle of an existing system (often referred to as a computer generation).

This dynamic characteristic introduces many uncertainties, for there is always the risk that, by the time a policy is implemented, technological change will have nullified the assumptions upon which it had been based.

Thus, technological forecasting in the past has been notoriously unreliable. However, the situation with respect to telecommunication and computers seems to be more favourable and there is little doubt about the usefulness of systematic attempts to forecast "surprise-free" developments. Indeed the American study states: "There is no major technology which will be used on a large scale in public telecommunication systems by 1980 which is not already under development or a least explored at this date".*

The rapid development of computer technology is pressing hard against communication technology. Consequently, as some of the major changes among the various components (such as the central processor, mass memories and terminals) are developed and introduced on the market, computation costs decrease, overcoming former technical and economic constraints. As a result, new applications which previously could not be justified or realised for economic and technical reasons now become possible. Thus, if it is correct that by 1975 there will be memory devices offering as many as one billion bytes of storage capacity, with 50 milliseconds random access time, for the price of about $ 300,000** many inquiry tasks on an interactive (real time) basis will be economically feasible. At present such units cost about four times as much. However, it is not possible here to provide a complete assessment of relevant technologies. Only some main trends in hardware developments relevant to telecommunication-based computer systems can be described:

Technology of electronic components - The development of small, integrated and very fast electronic circuits at decreasing costs was the breakthrough for the CPU in the early 1950s. Further substantial gains in speed and flexibility are expected through Large-Scale-Integration (LSI).*** Thus the large systems, such as ILLIAC IV, now under development at the University of Illinois, are reported to be 500 times faster than today's fastest commercial computers such as the CDC 7600 and the IBM 360/191.**** With LSI technology coming into play, it is quite possible that the computing costs will fall further by a factor of 40 to 50 in another decade.* In 1960 a typical computer could perform 50,000 multiplications per second. Now it can handle 375,000 per second. The cost to the customer used to be $ 1 per 100,000 multiplications; in 1963-1964 it was 25 cents; and in the near future it will be five cents.** This development is an essential factor in widespread distribution of computer power to many users.

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* President's Task Force on Communications Policy, Staff Papers, Staff Paper 1, Part 2, June 1969, p.i.

** Withington, Frederick G., "Trends in MIS Technology", in Datamation, Vol. 16, No. 2, February 1970, p. 110.

*** Integrated circuits are electronic elements carrying an entire circuit, (transistors, resistors, capacitors and interconnections) on one extremely small "chip" of silicon. Large-Scale Integration (LSI) may be defined as packing approximately 100 or more integrated circuits onto one chip.

**** SRI Report No. 7379 B-4, Patterns of Technology in Data Processing and Data Communications, February 1969, p. 17.

Technology of memories - In this segment developments under way are of strategic importance for data management automation in that they permit rapid access to any part of a very large store of information. Storage medium devices now entering the market can store in excess of 100 billion characters of information (more than 100,000 densely packed 400-page books)*** with access time short enough to retrieve any group of characters in a time scale suitable for use in an interactive system. Storage technology is expected to improve considerably in the next few years. Some proponents expect holographic memories to be on the market "at least in the read-only mode within five years".**** Other advanced and fairly cheap techniques, such as "plasma" memory devices (using ionized gas) for data storage and ferro-acoustic memory techniques (FAME) have recently been announced by the University of Illinois and the Electronics Division of General Dynamics Corporation respectively. Another very promising development may be opened by magnetic bubble computer memories. This technology, recently developed in Bell laboratories, may shrink the size of computers two-thousand-fold, to cigarette-package dimensions.*****

Related information technologies

Another very interesting technological development is gaining in momentum - Electronic-Video-Recording systems (EVR) and playback techniques.

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* "How Bell Labs Answers Calls for Help", Business Week, 23rd January 1971; Business Equipment Manufacturers Association, Comments on Docket No. 16979, Federal Communications Commission, Washington, D.C., 1968.

** Harter, L.M., McKenna and Wilkinson, General Electric Company Comments on Part V, Docket 18397, FCC, September 1969.

*** Parker, Edwin, B., Center for Advanced Study in the Behavioural Sciences, Stanford, California, Information Utilities and Mass Communications, 1970, p. 54.

**** Bradburn, J.R., RCA, "Where is the Computer Industry Heading ?" in Computers and Automation, Vol. 19, No. 1, January 1970.

***** "How Bell Labs Answers Calls for Help", Business Week, 23rd January 1971; Business Equipment Manufacturers Association, Comments on Docket No. 16979, Federal Communications Commission, Washington, D.C., 1968.

It is generally expected that these systems will offer economical memory functions and consequently allow a wide variety of information-retrieval applications. Basically there are now at least four different (and incompatible) systems in the prototype stage:[*]

- CBS - EVR (electronic video recording), employing a special fine-grain miniaturised film for playback on TV screens;
- Magnetic tape, using a magnetic video-tape on which images and sound are converted into video signals and stored in a cartridge; the playback unit sends these signals to the TV screen (Sony Videocassette; Cartridge Television Inc.'s Cartrivision; N.V. Philips's VCR);
- Plastic disc, jointly developed by AEG Telefunken and Decca Ltd., a video-taped programme transmits frequency-modulated signals to a master recorder cutting head, incising ultrafine grooves, 120-140 to the millimetre, in a master disc which then stamps out replicas in plastic; playback is provided by a high-speed record player, which translates pressure variations (analogue-represented data) into pictures on the TV screen;
- Holographic tape, an electronic video-recording system (termed Selecta Vision) which represents an even more advanced technology than other "mechanical" EVR's; it is based on the use of laser beams (i.e., coherent light) to record multiple images in a hologram.

The future market for these related communication devices is expected to be comparable with that of today's TV market by the end of the 1970s[**] and to play a major role in the information utility concept. Moreover, when cabled TV develops two-way communication, enabling set owners to deal in and pay a fee for special programmes, cable television in tandem with cartridges may become a new way of distributing first run movies and other features. Thus Goldmark sees the cartridge or cassette becoming the heart of home entertainment, education and information, with books, encyclopedias, magazines and libraries converted to the frames of his EVR cassettes, to be viewed in special print and animated illustration on home TV screens.*

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[*] The first prototypes which have been successfully demonstrated will be offered initially at a price ranging between $ 200 and $ 1,000 with recorded cartridges between $ 10 and $ 50 for a half-hour programme. Fortune, June 1971, p. 81.

[**] A recent study by Arthur D. Little for the American market projects 200,000 video player units in home use in 1972, 1,700,000 in 1974 and 3,900,000 in 1973. Cf. Fortune, June 1971, p. 81.

The Canadian report mentioned earlier has considered the latter development from the point of view of the relative costs of communications and cartridges. Thus, if the required wide-band communication costs remain too high, many such data bank services may be more economically supplied by individual libraries (as distinct from a nation-wide public service of video cartridges, playback equipment and minicomputers) for search and selection of all kinds of stored information.

One might also note that as a result of the above-mentioned technological developments such as integrated circuits and LSI, a new class of stand-alone, low-cost, small units, often termed minicomputers, has been developed.

Technology of Terminals

This largely parallels the increasing possibilities of interactive man-computer communications. Actually the commonest terminals in time-shared systems are typewriter or teletype terminals. Some systems use touch-tone telephone pads as the input medium, with voice recordings stored by the computer to provide voice-answers to the users. The major parameters for widespread use of this "entrance device" in the information utility are based on the technological development of the computer itself (integrated circuits, LSI) and the development of appropriate transmission facilities, such as wideband channels. It is commonly anticipated that most terminals will have some data-processing capabilities in order to undertake functions such as user identification, editing and post-processing of data: thus, it will be possible for terminals to perform economically many functions that have been given over to the computer.

For sophisticated application of the future, keyboard-equipped cathode-ray-tube terminals seem to be the device most requested and there is good reason to believe that the common TV set will play a significant role as an input/output instrument.

Further, either a very high data transmission link** is needed to fill the display screen, or some memory capacity has to be added, which in turn raises prices considerably. A promising and economic solution seems to be the plasma device (Bitzer console) or the ultra fast facsimile terminal (a derivative application of the picture-phone), both of which were described earlier in this report.

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* Fortune, June 1971, p. 177.

** For an image to be set up with moving events on a screen with a 512-line resolution, some six million bits per second have to be transmitted.

6.2 ADVANCES IN TELECOMMUNICATIONS TECHNOLOGY AND TECHNIQUES

Before discussing the new telecommunication technologies and techniques, it is useful to take a look at the main components of the public switched network with an eye to discovering opportunities for cost-reducing innovations as well as new telecommunications services. This approach might make it possible to identify some effects which technological advances are likely to have on the overall costs of transmitting information over telecommunication media such as twisted pairs of wire, coaxial cables and radio wave guides.

In technical terms the new telecommunication technologies promise to increase the efficiency of the network through improving the usable bandwidth, the signal-to-noise-ratio and the coding efficiency, mostly measured by the bandwidth consumed in transmitting a given amount of information, the error rate and the clarity of the signal received.

The main categories of the existing networks provided by common carriers are:

- transmission media;
- switching centres.

Within the transmission line (circuit) category a distinction should be made between the local loop network of a town and the long distance network between a town and the rest of the world and which consists mainly of coaxial cables and micro-wave facilities. In the local loop network twisted pairs of wire are the primary medium for carrying signals between local exchanges and telephone terminals. Since twisted pairs of wire are characterized by interference from adjoining circuits (cross talk), high data losses and inability to transmit broadband signals, they are considered the main bottleneck for adding telecommunication-based computer services and new telecommunication devices, such as facsimile and the videophone, to the existing public switched network. To put it differently, it is quite possible to send wide-bandwidth telecommunication services between two switching centres, but it is not as easy to distribute them from the local exchange to individual subscribers.

Although the new technologies cut through all the parameters described and influence each other mutually, the investment mix and thus the major cost bases of the main parameters are reckoned to be some 40% for the switching facilities and 60% for the transmission circuits.*

Consequently an investment strategy which is concentrated on improving switching technology - representing 40% of communication costs - will lead to a less significant reduction in overall communication costs than a strategy concentrated on investments in the circuit network, which represents 60% of the total cost.

6.2.1 Switching technology

Earlier in this report the function of the switching centre was defined as selecting from numerous possible combinations of transmission lines the path for a signal to follow. Thus the primary saving economy of the switching centre exists in its maximal use of existing communication lines.**

Besides these "functional economies" there are considerable operational economies within switching which the new technologies promise to bring about. The most recent key development in switching economies has been the elimination of operator assistance by automatic instead of manual switching (direct dialling). This has resulted in productivity increases in the range of 15-45%.***

Digital computers are beginning to replace step-by-step mechanical switching selectors in the networks in the United States, Germany and Japan. The switching computers are known respectively as ESS, EDS and DEX.**** The development is further proof of the blurring of boundaries between computers and telecommunications.

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* FITCE Report, p. 26.

** The economies of switching can easily be seen if one assumed that there were no switches and that every telephone set required a separate line to every other telephone set. Thus the present world telephone network, with some 300 million telephone terminals, would need 300 million x 150 million separate lines.

*** Commissariat du Plan, op. cit., p. 49. An American report has evaluated the cost reduction for an average telephone call by 45%; in the case of long-distance calls the reduction would be 54%. See President's Task Force on Communications Policy, Staff Paper 1, PB, 184 412. A Survey of Telecommunication Technology, p. 44.

**** ESS is a trade mark of AT and T, United States, and stands for Electronic Switching System; EDS - Electronic Data Switching - is a trade mark of Siemens A.G., Germany. DEX stands for Electronix Exchange System of NTT, Japan.

Some of the network economies brought about by electronic switching computers result from faster set-up times for making a connection:* the shorter this period, the more traffic switching and telecommunication circuits can handle. Thus this innovation would be a major step in expanding existing communication facilities in most Member countries, now suffering from heavily loaded telecommunication systems.

For the telecommunications-based computer user faster set-up times will also lead to considerable economies, since they will allow a better use of expensive computer time as well as reducing operational costs of staff and plant. More generally, full electronic switching promises the smooth introduction of new telecommunication services, such as large broadband services, conference calls, etc.

With the introduction of EDS-switching the German PTT administration expects network savings as a result of the more efficient operation of existing network facilities (alternative routing of calls and messages) without capital expenditure on the existing networks for at least five years.**

There are also economies of space and maintenance: electronic switching systems occupy much less space in a local switching centre than traditional electro-mechanical cross-bar systems and also need less maintenance. Space savings are, of course, most attractive in large towns with astronomical costs per square metre.

Another stimulus for introducing computers to provide switching functions and divide the enormous capacity of new telecommunication linkages into bandwidths which the various applications need is the future cost development of electronic components themselves. The cost of computing power has declined by an order of magnitude every four years and experts believe that this trend will continue for a while especially with the development of large-scale integration.*** Thus, with the expected trade-offs between electro-mechanical and electronic switching systems, AT and T is already installing some 300,000 electronically switched circuits annually.****

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* The economies may be illustrated by the following memory cycle times:
cross-bar switching system : up to 30 seconds
EDS switching computer : 5.5 microseconds
IBM 360/85 data processor : 100 nanaseconds.

** Private Information from the Fernmeldetechnische Zentralamt, Deutsche Bundespost, February 1972.

*** Armer, Paul, op.cit., p. 75.

**** "Digital Voice Communication", by George Flynn, in Electronic Products, March 1968, p. 14.

6.2.2 Transmission techniques and technology

It is now pertinent to discuss some developments in the transmission circuits of the telecommunications network, considered earlier to represent some 60% of total plant investment costs.

The basic characteristics of new communication techniques and technologies (such as digital modulation, development of economical wideband, two-way distribution systems and satellite technologies) are that:

- they match the bandwidth limitations and improve the quality of transmission as well as the feasibility and capacity of existing networks, especially in the local urban loop;
- the new microwave and satellite technologies promise to eliminate distance as a significant communication cost factor, which could lead to a corresponding tariff reduction in all telecommunications services, such as voice (telephone), facsimile, TV and data transmission, and thus open up fascinating prospects for the information utility concept.

Table 14 provides a survey of the current innovative process in telecommunications technology. If this presentation is compared with the electro-magnetic spectrum (Table 15), i.e., the medium for transmitting information "electrically", the new technologies can be understood as innovations for using new frequencies of this spectrum and/or as a means to exploit more efficiently those frequencies which are being used at present.

a) The urban-local network

It was argued earlier that a serious bottleneck for new telecommunication services, such as videophony, facsimile and data transmission, exists within the local urban networks. This is because the twisted pairs of wire, which are the primary medium for carrying signals between local exchanges and telephone terminals (Table 16) have a capacity of only 2,000 bits,* whereas new telecommunication services would need much higher transmission rates - a videophone, for example, calls for about one million bits.

The new PCM technique,** using repeaters*** spaced at 1.15 miles, increases the capacity of a conventional twisted-pair cable for

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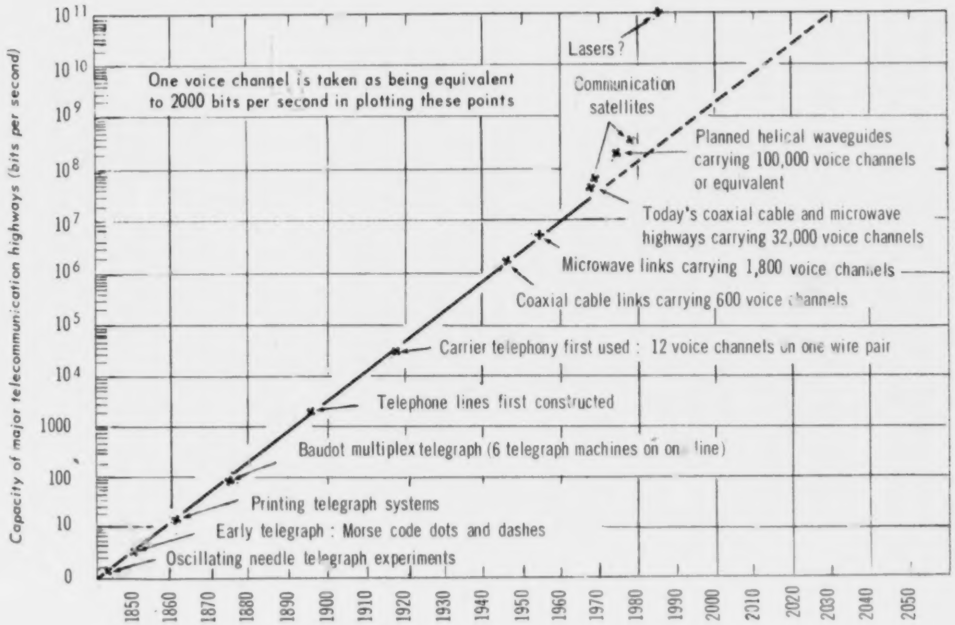
* One voice-channel is taken as being equivalent to 2,000 bits per second to facilitate the comparison.

** Pulse-code-modulation, a technique to replace analogue-signals with a series of binary (or on-off) pulses.

*** Repeaters amplify dying signals along a cable's route.

Table 14

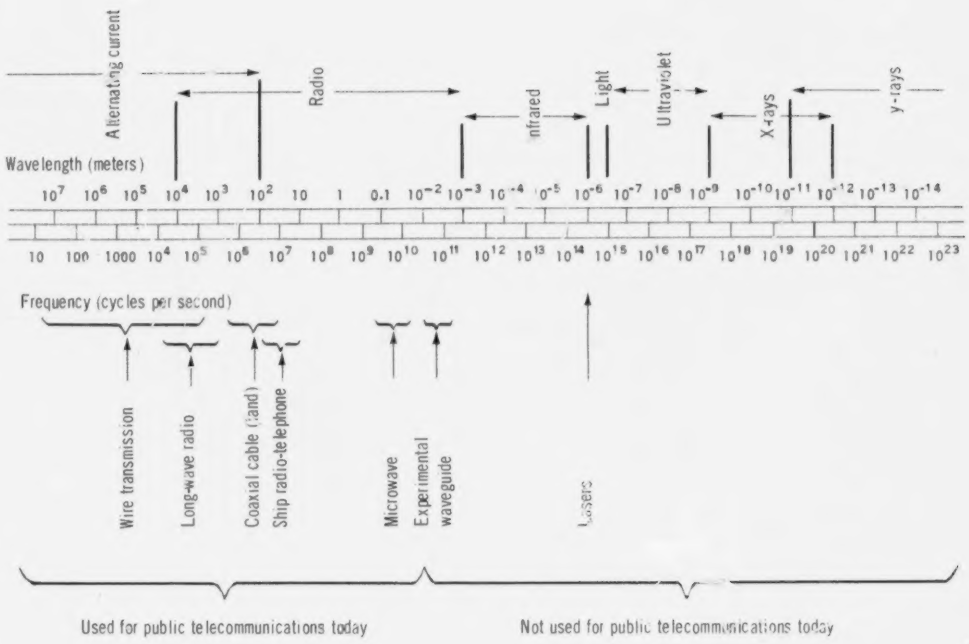
THE SEQUENCE OF INVENTIONS IN TELECOMMUNICATIONS



Source: James Martin, Future Developments in Telecommunications, 1971, p. 342.

Table 15

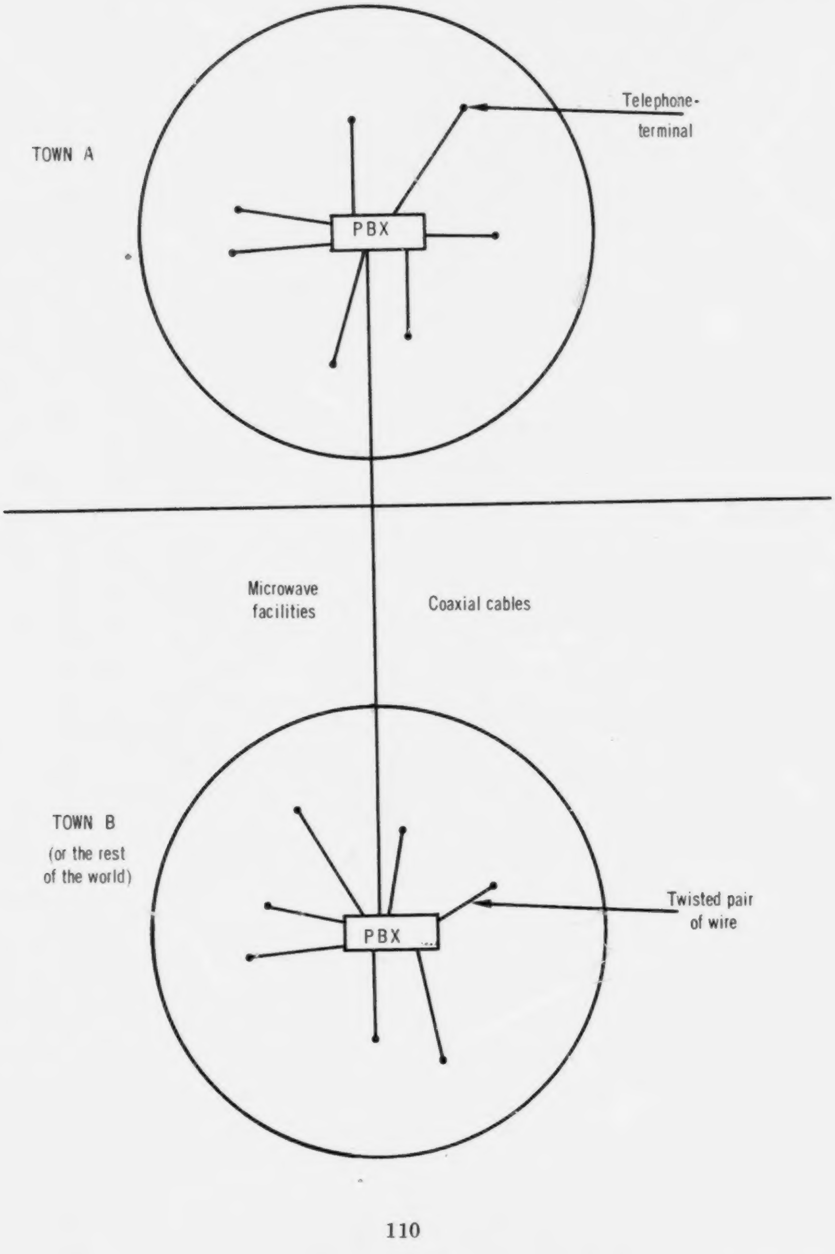
THE ELECTROMAGNETIC SPECTRUM



Source : James Martin, Telecommunications and the Computer, 1970, p. 139.

Table 16

COMPONENTS AND CONFIGURATION
OF A PUBLIC SWITCHED TELECOMMUNICATIONS NETWORK



one-way transmission of 1.5 M bits/sec. If low-capacity paired cable (which still costs far less than coaxial cable) is used, rates as high as 6.3 M bits/sec. are possible.*

The rapid expansion of cable TV services, especially in Canada and the United States,** represents another important development for traditional as well as new telecommunication services.

Originally intended to be no more than a means of improving television reception, it now promises to affect the entire field of telecommunications. This wideband system uses coaxial cables, which interlink subscriber terminals.

b) Long-distance communication media

As reference to all new development in coaxial cables, helical waveguide,*** laser beam and satellite technology is beyond the possibility of this report, it may be sufficient to characterize them globally as being capable of tremendously improving transmission capacities. Through large trunk groups these new technologies eventually permit considerably lower transmission costs. As a rule of thumb, doubling the number of circuits in terrestrial transmission media involves an increase in total cost of only 60%.**** The trade-off between channel density and the relative costs of different terrestrial transmission media are shown in Table 17.

Bell***** estimates that for 1980 the average incremental circuit investment per voice circuit will drop from $ 11 to about $ 1.40.

"Wired cities" interconnected via satellite communications have been widely discussed. The trade-off calculations between terrestrial and satellite communication media - based on total systems costs - show satellite transmission economically superior

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* Telecommission, p. 34.

** Cable TV also exists to a limited extent in the United Kingdom, Belgium (Liège, Brussels) and Japan (Tokyo, Osaka).

In France the group "Télédistribution", i.e., some 200 technicians of the French P et T Administration and the ORTF (Television and Radio Broadcasting) Administration is studying the feasibility of introducing Cable TV. The service will probably be available by 1974 in Créteil or Cergy-Pontoise (near Paris) or in Saint-Jean-de-Monts (Département Vendée).

Source: Postes et Télécommunications, Paris, No. 195, Mars 1972, p. 5.

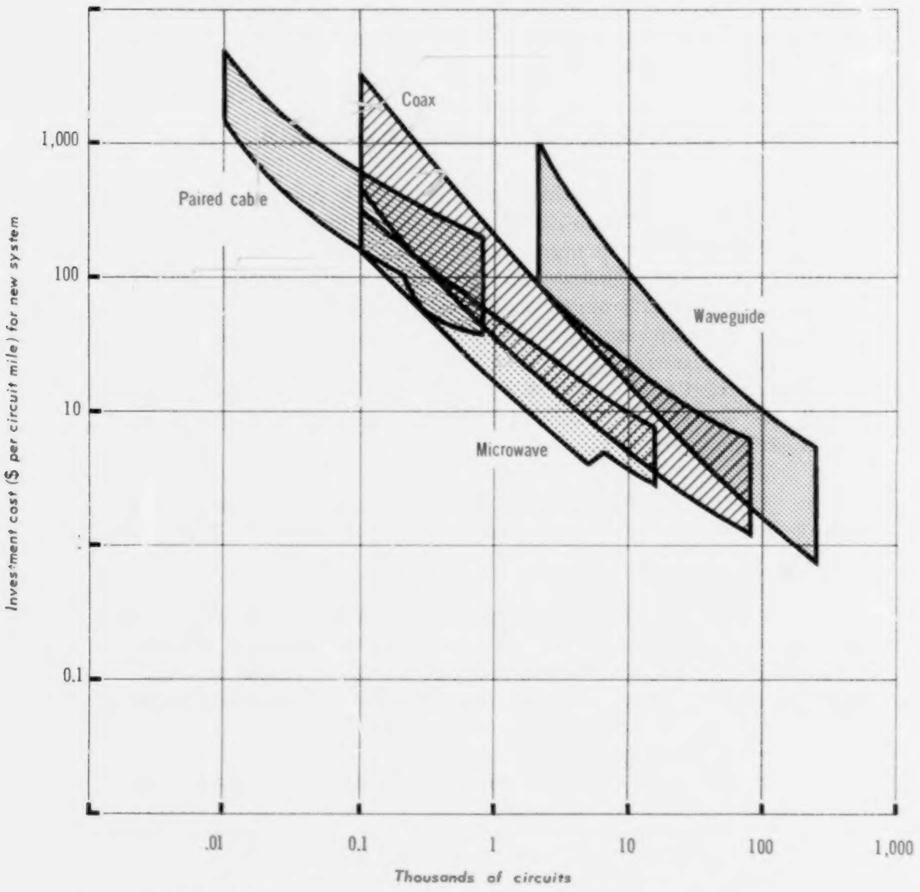
*** The helical waveguide is, in essence, a metal tube, through which travel radio waves of very high frequency.

**** President's Task Force, Part 1, p. 35.

***** Ibid., p. 37.

Table 17

COST TRENDS IN TERRESTRIAL TRANSMISSION MEDIA



Source : President's Task Force on Communications Policy Staff Paper I – A Survey of Telecommunications, June 1969, p. 35a.

to terrestrial lines or microwave systems for distances in excess of 500 miles (assuming 1971 technology).*

Digital communication techniques also promise to reduce communication costs in both terrestrial and satellite systems. Thus it is estimated** that "a ten-station FM-FDMA system with a capacity of 450 one-way voice channels could provide 900 channels if PCM/PSK-TDMA were used".

6.3 NETWORK CONFIGURATIONS

6.3.1 Separate digital network

Some authorities argue that although the development of the videophone and cable TV are of vital importance to the grand design of information utilities, there are some urgent decisions in communication policy to be taken now, to satisfy the daily demand of telecommunication-based digital computer systems. The discussion centres around the question of whether the optimum means of providing data transmission services could be achieved by:

- the integration of these services with conventional telephone services (integrated approach), or
- the construction of a separate (dedicated) digital network.

A recent study compared the investment costs for data users on an analogue (telephone) system with space-division switching versus a digital communications system with time division switching. Table 18 shows the results of this study, based on a demand of 1,000,000 subscribers distributed over 100 cities.

A dedicated network of this kind could offer teleprocessors an increased choice of ban.. widths, as well as cost savings of a least 50%.***

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* This is why the CEPT Administrations have agreed that 800 km. could be taken as the minimum length of terrestrial route from which circuits might be transferred to the satellite system, rather than the distance of 1,200 km. on which earlier studies have been based.

Source: European Space Research Organisation. Interim Application Programmes Committee. ESRO/IAPC(71)18. Att.: Annexes I and II T/CCTS(71)24E. Neuilly, 26 July 1971.

** Telecommission Study 5(a), (b), (c), (d), (e), 1971, p. 34.

*** President's Task Force on Communication Policy, Part 1, p. 10.

Table 18. NETWORK COST COMPARISONS PER CUSTOMER

U.S. Dollars

FUNCTION	ANALOGUE NETWORK	DIGITAL SUB NETWORK	
		HIGHEST	LOWEST
Conversion of digital signals	500	0	0
Local distribution	256	292	292
Local switching	184	92	37
Toll switching	25	12	5
Trunking			
(terminal)	50	17	5
(line-haul)	50	55	55
Total	1,065	468	394

SOURCE: President's Task Force on Communication Policy, Part 1, p. 47.

a) Criticisms of the dedicated network approach

To overcome the shortcomings of the existing analogue telecommunications network for handling digital data traffic between:

- man-man
- man-machine
- machine-machine

telecommunications experts have launched the idea of building a dedicated data transmission network, physically separated from the existing telephone network.

However, this separate network approach has met with severe criticism. It is argued that, with the establishment of a separate data transmission network, the innovative capabilities of PCM (pulse code modulation) techniques for telecommunications services for telephone, for example, cannot be exploited. Tariff decreases in the range of 54-90% reported.* Thus those countries which, compared to the United

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* See MCI and Datran proposed tariffs filed with the FCC (United States).

States, Sweden and Switzerland, are already under-equipped, could fall even farther behind. (See Table 37). A crisis in telephony would, therefore, be projected.

There are good reasons for favouring the integrated approach. From an investment-resources point of view, the FITCE experts* argue quite straightforwardly that investment costs for a separate network would be extraordinarily high; and they are convinced that a one-way system could manage considerably less traffic than a system with two-way traffic. Other experts strongly deny that a separate network would be economical and consequently see the only possible approach as an integrated network - integrated to handle voice, facsimile, pictorial and digital data in the same network.

In addition, it is argued that PCM-oriented LSI circuitry for a multi-purpose network serving analogue as well as digital customers could allow mass production and cut costs considerably. Today the necessary equipment would cost about $ 1,500 per subscriber. Optimistic predictions for the mid-1970s place the possible cost at $ 50 per subscriber,** if the entire telecommunication network were to be built around digital transmission. Bell's philosophy is that digital technologies and an integrated approach for human voice and computer communications are the best answer to most of the communication needs and requirements which arise. Today the Bell system has thirteen million miles of digital communication channels and is adding to them at the rate of 8,000 miles a day.***

Another advantage is that digital communication channels disregard the character of the inputs they have to handle. Once the information gets into digital form it looks the same to the line whether it is voice, data, video, facsimile, real time, or non-real time or whatever. In addition this ability to interleave all types of signals will lead to greatly increased standardization of equipment, maintenance and high service quality - as Hoth points out.****

From an application point of view, the importance of an integrated network design approach is further emphasized. As a possible working tool, to rationalize the time - and paper-consuming work in service industries, the computer telecommunication complex will have to handle both digital and analogue represented data. This is because it will be impossible and uneconomic to convert all kinds of information into digital form. To put it differently, frequently-accessed information or indexed material would already be digitized at the collection stage and stored for later manipulation in a digital computer/data base complex (typically with computer magnetic disc storage).

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* FITCE Report, p. 45.

** IEEE Spectrum, December 1965, p. 57, and President's Task Force on Communication Policy, Part 1, p. 48.

*** Bell's advertisement in Datamation, 15th September 1971, pp. 46 and 47.

**** Flynn, George, "Digital Voice Communications, Electronic Products", March 1968, p. 14, cited from President's Task Force on Communication Policy, Part 2, p. 21.

On the other hand, there are large quantities of less frequently used information, and information that is inherently analogue, such as graphics, maps, personal identity references (passport pictures, signatures). Such inherently analogue information is not directly manipulatable by computer and their conversion and coding into digital form would be prohibitively expensive. However the videophone seems to be an economical way of by-passing this extremely expensive conversion and coding process and the selection and transmission of this material could, again, be under computer control, as was successfully demonstrated in the case of the Bitzer console.

Since the separate networks at present being discussed would not include videophone and cable TV capabilities, many experts strongly recommend the integrated network approach.*

It is further argued that, with the decision to build a dedicated computer-oriented telecommunication network, another technological "fix" would be established, which again would be a serious barrier to a transparent overall design at a later stage.

Finally, to prove the economies of a dedicated data network, physically separated from other telecommunications networks, reference is often made to the MCI and Datran concepts.** In their application to establish a microwave network in the United States, MCI, for example, has filed with the FCC tariffs which are 50% to 94% lower than existing rates of AT and T point-to-point services of a similar nature.***

b) Economies of integration

It was argued in the preceding chapter that the entire telecommunication network may eventually be built around digital transmission. Table 46 gives an idea of the organisation of such an integrated network. The advantages claimed are:

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* For example, Parker, Edward, "Information Utilities and Mass Communications", in The Information Utility and Social Choice, 1970, p. 54.

** MCI = Microwave Communications Inc.

*** "Before the Federal Communications Commission, Comments of the MCI Carriers," Docket 18920, October 1970, p. 135.

- extraordinarily high transmission quality;
- high degree of flexibility in terms of network adaptability and service extension capabilities;
- possibility of multipurpose telecommunication networks;
- possibilities of gradual parallel packaging of different channels;
- possibility of providing distinct telecommunication services, such as telephony, facsimile, videophone and data transmission on the same physical network;
- considerable telecommunications service tariff reductions.

The concept of the economies of integration is based on the common sense argument that lower communication tariffs can be achieved if all telecommunication services are combined within one network, leading to economies of scale and thus lower unit costs. Consequently the concept has been expanded insofar as the existing common carriers have requested that, in order to prevent duplication of telecommunication and data processing facilities, both should be operated by the same organisation: i.e. existing common carriers.

The carriers argue that economies might be realised if they were permitted to enter the data-processing field, based on these considerations:

- Common carriers' know-how, manpower, space and other resources would be directly applicable to the design of a total communication/data-processing system.
- Telecommunications and data-processing technology are merging rapidly. As integrated solid state devices are further introduced in designs, the circuit components of computers and telecommunication switching equipment will become identical. This means that system design know-how within telecommunications and computers will become increasingly related and interchangeable; standardization in the various components in turn would lead to industrialised mass production and subsequent economies. Further, as it was pointed out earlier, the same units could with some additional programming and incremental costs provide data-processing services.
- Accordingly, the customer would be able to buy the wide range of services with one simple provider of total information systems.
- Lastly, economies of large scale research and development could be achieved.

Martin* calls this "the best of all worlds" and argues in favour of immediate introduction of the switched data network. But telephone authorities are not yet ready to make the desirable but extremely expensive changes in existing telephone networks.

However, there are differing expert opinions about the technical possibilities of such an integrated network and the likelihood of economies. Consequently this report recommends that a study be initiated immediately to determine the advisable policy. The economic necessity becomes obvious, particularly in the case of those countries which have to satisfy both telephone communications and data transmission.

Germany, for example, wants to achieve the telephone density of 50 telephone sets per 100 inhabitants - the 1970 density of the United States, Switzerland and Sweden - by 1990. In order to do so it would have to invest some 60 billion Deutschmarks within the next twenty years, if costs are to be reduced from DM 3,500 to DM 3,000 per main telephone connection.**

6.3.2 Circuit switching versus store and forward switching

Closely related to electronic switching of lines to establish a communication path between two remotely sited subscribers is the integrated use of computers for:

- line switching;
- store and forward switching;
- data processing.***

It is because of these blurred boundaries between telecommunication and computers, among other things, that the issue of integrating data-processing and telecommunications in one company has arisen.

In this context (if the combined line switching and data processing function is technically feasible) it is argued that economies of integration might result from sharing computer power for switching and data-processing, as spare capacity becomes available according to the load fluctuation of networks during the day.

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* Future Developments in Telecommunications, 1971, p. 96.

** Böhm, Erich, Modelle für Entwicklungs-Prognosen im Fernsprechwesen, 1970, p. 13.

*** Experts in the telecommunication field emphasize that at the moment "switching" computers (AT and T's, ESS and Siemens EDS) are used only for line switching and have no data processing capacity.

However, in current discussions two very different switching functions (and thus system configurations) are envisaged:

- circuit or line-switching;
- message or store and forward switching.

The main differences between the two techniques can be loosely characterized as follows:

1) Computers utilized to manage the circuit-switching function, as in a network dominated by telephone services, are programmed according to the typical requirement of this "real time" service: to establish an uninterrupted, continuous connection "dedicated" to the call until it is finished.

2) Store and forward switching, on the other hand, relays messages after a delay. Thus message-switching computer-systems do not create a physical link for the data to flow over. Usually, as in air-reservation-retrieval systems, messages enter the system from a terminal, are stored in a computer and then forwarded to their destination when a line is available or information is requested. Under "packet switching," A simply makes up a short message or "packet" of information, attaches a note saying "send this to B" and enters it into the system. This message is read and forwarded by the best possible route. As no dedicated circuit is set up, equipment may be utilized more fully. In addition, the operating costs are dominated by the quantity of information sent rather than by time and/or distance.

Digital computers usually provide the store-and-forward ability in the modern message (package) switching systems, such as the SITA Network, Western Union's INFO-COM and SICOM services, the one developed by the National Physical Laboratory in the United Kingdom, and ARPA Network in the United States.

Within the discussion of an integrated network which is completely transparent to the signals passing, electronic circuit switching seems to be superior to store and forward switching. The following characteristics are usually cited as arguments in favour of circuit switching:

- real-time on-line data applications which promise to have the highest growth rates have favoured the use of circuit switching;
- circuit-switching equipment is completely transparent to the kinds of signals passing through; it is insensitive to data code and format and will handle any speed up to its

design limits;* thus it can handle both data and voice signals in one network.

In addition, message-switching - besides its expensive apparatus of third generation computers - is considered rather as an ancillary service to data-processing.**

However, it might well prove that both services will have to be ultimately met and satisfied. Thus steps should be taken to decide what kind of network configuration is best capable of allowing all communication requirements in the long run.

6.3.3 The "Wired City" concept

It was argued earlier in this report that there are basic technical constraints within existing telecommunication networks which prevent:

- new telecommunication-based services,
- handling of the rapidly growing demands of traditional telecommunication services.

It is generally agreed that the telephone system, although highly developed and allowing some 300 million people around the world to communicate, suffers from the fact that it utilizes pairs of copper wires as its local distribution facility and is thus suitable for handling only signals of telephone or low-speed data type.

To overcome these bandwidth limitations a seminar*** suggested the possibilities of a "wired city", i.e., a city with a capacity "for total communications".****

According to this study***** it seems possible, at least conceptually, to increase the telephone system's capacity by replacing its copper pairs with coaxial cables, thereby forming a switched coaxial cable system which would also allow the re-allocation of the overcrowded electro-magnetic spectrum.

It is also reported that the British Post Office are convinced that this is a viable concept and have an experimental system operating in their laboratories at Wembley as the forerunner of multi-service coaxial cable systems to be installed throughout Britain during the next 20 years. However, it was reported at the same seminar that the Dutch Post Office authorities have come to the conclusion that it is impossible to integrate their television system with other telecommunication services and have abandoned the idea.*

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* Mathison, Stuart L. and Walker, Philip M., Computers and Telecommunications, 1970, p. 49.

** President's Task Force on Communications Policy, Part 1, p. 44.

*** Telecommission Study 6(a), Reports on the Seminar on the Wired City, Department of Communications, Canada, 1970.

**** Ibid., p. 8.

***** Ibid., p. 9.

Existing cable TV networks employ broadband coaxial cable providing 300 times the potentiality of copper-pair. This is different from the "wired city" configuration which is two-way and switched.** These experts believe that such a broadband system might be possible within ten to fifteen years and describe the "wired city" total information system as*** "a switched coaxial cable system which would have the same philosophy of operation as the existing telephone system" and would accommodate such services as those shown in Table 19.

Table 19. POSSIBLE SERVICES
OF A BROADBAND SWITCHED NETWORK

- advertising
- pictorial consumer information
- alarm (burglar, power failure, fire, etc.)
- banking
- facsimile (documents, newspapers, etc.)
- emergency communication (hospital beds)
- communication between subscribers and computers
- meter reading (utilities)
- distributing of radio programmes
- shopping from home (see experiment in San Diego)
- TV (originating and distribution)
- TV (stored movies, available on demand)
- educational TV
- telephone
- computer-aided instruction
- picturephone (videophone)
- voting, etc.

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* Ibid., p. 9.

** Whether there is a two-way communication on the same cable that is used for transmission to the home or whether parallel lines will be provided for return communications is primarily an economic matter, dependent on the cost of repeater devices in the cable. San Jose Cable TV has laid parallel communication lines for such return communications to a computer and considers it currently as a cheaper solution than using two-way repeaters. (Private communication from A. Latham, San Jose Cable TV Co., November 1969); see Parker, Edwin B., Information Utilities, p. 55.

*** Telecommission Study 6(a), Reports on the Seminar on the Wired City, Department of Communications, Canada, 1970, p. 9.

Perhaps a harbinger of greater public interest is the report of the New York City Mayor's Advisory Task Force on CATV and Telecommunications* which proposed making cable television service available to every home in New York wishing to subscribe within two or three years. It recommended that, in addition to carrying local television signals, the cable should be used for programme organisation and should reserve three channels for municipal purposes. The report also noted the potential future development of CATV into a new urban telecommunications system, perhaps becoming "the transmission belt for all mass information".

In Japan, the concept of the "wired city" will become reality in Tama New Town - a new satellite town of Tokyo. In a $ 19 million project - to be begun in 1972 - a large number of apartments will be interconnected by a coaxial cable network. The following services will be available to subscribers:

- video broadcast on request;
- computer-aided instruction;
- data retrieval;
- shopping guide;
- facsimile newspaper system (to retrieve the major Japanese daily newspaper);
- simultaneous rebroadcast of TV programmes;
- various seat reservations (hotel, plane, theatre);
- telemetering (automatic measuring of household electricity, gas and water consumptions);
- tele-control (switching and control of household appliances);
- cashless systems.

Similarly, there has been a recent statement from the FCC which for the first time publicly noted that "the expanding multichannel capacity of cable systems could be utilized to provide a variety of new communications services to homes and businesses in the community". It listed, among the possibilities of a "wired city" concept, such information utility services as "facsimile reproduction of newspapers, magazines, documents, etc.; electronic mail delivery; merchandising; business concern links to branch offices, primary customers or suppliers; access to computers, e.g., man-to-computer communications in the nature of inquiry and response (credit cheques, airlines reservations, branch banking, etc.) information retrieval (library and other reference material, etc.) and computer-to-computer communications". It referred to the possibility for CATV to develop "capability for two-way and switched services", and, through high capacity intercity communications and computer technology, to become an element in "new nationwide or regional services of various kinds".*

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* Mayor's Advisory Task Force on CATV and Telecommunication. A report on cable television and telecommunications in New York City, 14th September 1968.

More recently, in a proceeding involving telephone carrier-CATV relationships, the Commission again referred to the variety of potential services involving data transmission, which could be provided over the broadband cable in addition to CATV, and to the "real potential that such services will be furnished over regional and national networks consisting of local broadband cable systems interconnected by intercity micro-wave, coaxial cable and communications satellite systems".**

Moreover, it is important to show that there is at least one feasible path by which the present media systems could evolve to the kind of public information utility system defined above.

Most experts agree with Cable TV Industries' prediction that close to 50% of United States and Canadian homes will have cable access by 1975.*** Consequently, the FCC in considering policy issues involving the relationship of CATV to broadcasters and common carriers is now forcing CATV providers to include two-way communications for new services, which will lead, through mergers between cable TV operators and computer time-sharing companies, to the offering of computer-based services via cable TV.

For the near future, Parker predicts**** as the next step the development and marketing of devices that will permit existing standard TV sets to be used as CRT display terminals. It seems likely that new all-purpose home communication terminals designed from the start for both television and computer services and also for playing video recordings will be developed.

In the meantime, however, the large number of television sets already in existence makes it likely that there will be a large market for an "adapter" that will permit these sets to be used for this purpose. Parker predicts that such "adapters" are likely to be built for connection to telephone systems as well as to cable TV systems.

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* FCC Docket No. 18397, Notice of Proposed Rule Making and Notice of Inquiry, adopted 12th December 1968, paragraphs 8-9.

** FCC Docket No. 18509, Final Report and Order adopted 28th January 1970, paragraph 47.

*** Dunlop, R., "The Emerging Technology of Information Utilities", in The Information Utility, p. 33.

**** Parker, Edwin, The Information Utility, p. 60.

Chapter 7

BASIC MACRO-ECONOMIC CONSIDERATIONS

7.1 COMPUTER GROWTH

In terms of dollars, computer systems installed in 1966 represented some $ 60 billion and were estimated in 1970 at a world-wide figure of some $ 100 billion. Concerning the years to come, predictions have to be treated with some caution. The figures for the Unites States were mentioned earlier: $ 160 billion to be invested in computer technology and about $ 100 billion in telecommunication facilities.

In 1971 the Canadian Science Council noted that the "electronic computer may well be the basis in the 1970s of the world's largest industry after petroleum and automobiles, and just as these existing industrial complexes have wrought innumerable changes in contempory society, so the computer industry will play a major role in shaping the society of tomorrow".* Similar predictions were made in 1966 by IBM's World Trade President, Jacques G. Maisonrouge.**

These predictions, rather than dollar investment figures, indicate the importance of computer/telecommunication technology as a basic infrastructure for national economies, besides being a key industry itself in the near future. (The first category includes both the availability of computer power and the derived capabilities it offers to all sectors of the economy.)

With regard to specific nations, an analysis of the British market estimates that total expenditure for computing*** in the United Kingdom will approach 4% of GNP by 1980.****

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* Science Council of Canada, August 1971. Report 13, "A Trans-Canada Computer Communications Network", 9.

** Stoltenberg, G. "Benötigt die Bundesrepublik Deutschland eine eigene Entwicklung von Datenverarbeitungsanlagen?" in Computer und Angestellte, Europäische Verlagsanstalt, 1971, p. 249.

*** Here the computer industry is defined as comprising only EDP manufacturers, software houses and service bureaux; communications carriers, are not included.

**** Hoskyns Group Limited, United Kingdom Computer Industry Trends, 1970-1980, October 1969.

In France, the computer industry is expected to overtake the automobile industry in dollar volume by 1976.*

In Japan, installed computer systems will account for 2.3% of GNP in 1975, according to the government's plan to promote computer utilization.

A Canadian study yielded similar results. It estimated that the total value of computing, telecommunications and soft-ware will account for 2% to 5% of GNP in 1979. (This compares with 4% of GNP Canadians spent on new cars in 1968.)**

7.2 GROWTH OF TELECOMMUNICATIONS SYSTEMS

With respect to the demand for existing and new telecommunications services and their rate of growth, some recent predictions have been discussed, especially in the United States and the United Kingdom. It has been estimated that the demand for telephone services alone will at least double by 1980 in the United States.*** Other predictions state that the growth of transmission facilities is exponential - about 15% per year. Thus, if these predictions are correct, telecommunication facilities will double every six years, or every five years if telephone trafic follows CEPT estimations.****

Where growth of digital transmission is concerned, estimates are more difficult. The growth of computer systems within one decade, too, is impressive; yet it represents only the initial stages of future growth. It has been estimated that by 1972 some 60% of all computers were tied into telecommunication networks and that the volume of data transmission exceeded that of voice transmission.***** Correspondingly it is expected that by 1980 in the United States, some 90% of computers will be telecommunications-oriented. Similarly, in the United Kingdom, half the data-processing installations will be on the network by 1973 or 1974 and by 1980 the proportion will have risen to 90% or more.*

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* "Le marché de l'information", L'expansion, Paris No. 21, July - August 1969, pp. 96-105.

** Science Council of Canada, August 1971, No. 13, p. 9.

*** Science and Technology, April 1968, p. 55.

**** Plan et Prospectives, 1970, p. 47.

***** Strassburg, Bernhard, "The Computer Utility - Some Regulatory Implications", in Jurimetrics Journal (September 1968), p. 20.

According to IBM's response to the FCC inquiry on interdependence of computers and communications, 50% of all computers will have communication capability by 1978. See Dunlop, Robert A. The Emerging Technology of Information Utilities, p. 30.

7.3 SOVEREIGNTY ASPECTS

Although this array of numbers and projections may invite questions, one fact emerges clearly; computer/telecommunications industries have immense economic vitality and growth potential. Consequently, the question has arisen in some countries as to whether they are prepared, in technological and industrial terms, to take up their options in this key economic activity. The Canadian report mentioned previously emphasizes the possible implication for national sovereignty in the case of governments failing to provide an adequate policy to achieve national targets. The issues related to these sovereignty aspects originate from the fear of foreign ownership of the computer-utility industry, comprising:

- computer-hardware manufacturers;
- software houses;
- service bureaux;
- telecommunications equipment manufacturers;
- common carriers;
- broadcasters;
- terminal manufacturers, etc.

This could result in a nation losing control of what most experts predict will become the largest and most vital industry in the years to come.

After the CPU predominance** by the United States, some authors are predicting a similar "national software, telecommunication disaster"*** if the trend towards foreign dominance in this field continues to develop.

This seems to be particularly meaningful for Member countries who have only limited access to satellite technologies. Since the two existing telecommunication satellite systems, Intelsat**** and the Russian

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* Gill, Stanley, "Telecommunications and the Computer Industry" in Moonman, British Computers and Industrial Innovation, p. 32.

** See "Government support for the hardware industry" by Eric Lubbock, in British Computers and Industrial Innovation, 1971, p. 6.

*** Statement by Plessey (I-291) at Subcommittee D, quoted by Eric Lubbock, loc. cit., p. 1.

**** Intelsat, a world organisation founded in 1964, has been in a unique position: Comsat, an ingenious, mixed private and public company was both the manager of this world system and the representative of the United States to Intelsat.

Intersputnik systems, are not, specially in political terms, real alternatives.

This position to date has remained unchanged. Efforts of ELDO (European Launcher Development Organisation) and ESRO (European Space Research Organisation) to construct a European communication satellite have not yet got off the ground. The same is true of the Franco-German project, "Symphony", and the Italian approach, "SIRIO", both of which depend heavily on the success of the launcher to be provided by ELDO and ESRO.

Consequently, if a domination in the field of communication satellites, similar to that of computers ten years ago, is to be prevented, a new application-oriented approach, distinct from the national technology approach, is imperative at policy level.

7.4 TOWARDS A NEW COMMUNICATIONS POLICY

Up to now, government support for the development of science-based technology, such as computer technology, has shown disappointing results, despite the enormous funds consumed. This has been largely because efforts have been centered too much on spectacular hardware technology and too little on the practical needs technology might serve.

With the trend away from a CPU-technology philosophy towards an application-oriented telecommunication-based EDP philosophy, there is a fresh chance for OECD Member countries to take up their options in these important economic spheres. It is therefore suggested that individual, industrial, commercial and government needs for computer/telecommunications systems should be anticipated and an appropriate strategy worked out for shaping the direction of new hardware developments.

The opportunity for taking up these national options is increasingly at hand as:

- the patterns of computer usage change and new technological advances come into being;
- the structure of the new industry is no longer dominated by a few computer hardware manufacturers, but is becoming a much more complex affair in which software houses, service bureaux, peripheral device manufacturers and telecommunications play a major role.

In addition, as communications become a strategic parameter in terms of costs as well as technology, it is believed that a communication policy could meet both challenges: establishing guidelines for users and industry by setting technical standards for computers, mini-computers, terminals and cassette devices on national and international levels.

Conflicts of national economic interests observed in the past (which led to what has been called "CPU nationalism", could on the basis of an advanced telecommunications policy, be isolated and their gravity assessed, so that some agreement might be reached and the conflicts resolved well in advance of the time when specific new facilities are to be installed.*

Such a policy would be the sine qua non for an internationally competitive information-processing components industry and would thus do away with protectionist national responses.

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* Whitehead, Clay, International Communications - An American View, July 1971, p. 11.

Chapter 8

STATE OF THE ART

8.1 A CHALLENGE TO COMMON CARRIERS

It has been stated that there is a wide gap between potential and applied telecommunications technologies and techniques. Because of this, available telecommunications services are not the limiting factor only in development of new data transmission services within the computer utility concept, but also in providing traditional telecommunications services, such as telephony.

Consequently, it may be asked what strategy common carriers propose to overcome this binding situation. With reference to all PCM digital networks, the question is whether common carriers will embark directly on this challenge or look for a compromise solution to the problem of whether or not to integrate voice and data networks. Thus it is of vital interest to know the characteristics of their planned networks, such as the transfer rates, speeds, flexibility and tariffs of the new services planned. It would also be of interest to investigate the methods by which these characteristics have been defined, i.e., how user needs have been evaluated.

In discussing new telecommunications technologies the question of possible savings in telecommunications services has been kept in mind. Ideally, this chapter should also reveal whether the organizational structure of traditional common carriers in Member countries are appropriate for assessing these technologies in the light of societal imperatives: public interest, convenience, and reasonable tariffs. If a comparative analysis should prove the opposite, it might well be recommended that the present "natural monopoly" concept, as practised in most Member countries, should be abandoned.

8.2 ACTIVITIES PLANNED IN TELECOMMUNICATION SERVICES

To repeat, telecommunications services are generally offered in a "natural monopoly" environment. In most OECD countries telecommunications services and facilities are under government control and thus one single administration is usually responsible for the procurement of these services. Its role is to create a well-balanced and co-ordinated programme, taking into account:

- user needs, (individual, industrial, commercial, governmental) for telecommunication-based computer systems and other telecommunication services;
- the development of the information technology (procurement of computers, development of computer and computer-related industries, generation of know-how, etc.);
- the development of the communications technology (procurement and improvement of all telecommunication facilities, etc.).

Table 20 could be interpreted as the quantified demand for telecommunications-based computer systems as the respective telecommunication administrations are considering it. This forecast of digital data terminals shows the current demand for telecommunication based computer systems and reveals the expected growth of these services expressed in terminals and/or modems in selected Member countries.*

8.3 EXISTING AND PLANNED DATA-NETWORKS

The terminals enumerated in Table 20 at present show annual growth rates up to 100% and promise to be a highly lucrative market. Some national common carrier approaches to the satisfaction of telecommunication requirements arising from these will now be discussed. Currently, data communication traffic accounts for about $ 650 million in AT and T revenues alone and market studies project a ten-fold increase in the decade ahead.**

Australia: The Post Office data facilities include access to the telex network (circuit switching) from the data networks of some government departments. Additionally, the datel service (data on the telephone network) offers on the switched network (circuit switching)

* See more detailed discussion of terminal forecasts in Chapter 9.

** See Annual Report, American Telephone and Telegraph Company, 1971. p. 5. (In 1970 it was some $ 500 million, i.e., an annual growth rate of 30%.)

Table 20. FORECAST OF DIGITAL DATA-TERMINALS AND/OR MODEMS

COUNTRY	1970/71	1975	1980
Canada[1]			
Belgium	400	5,000	50,000
Denmark	700	16,000	56,000
France	2,000[2]	50,000[3]	-
Germany	4,300[2]	8,000	68,000
Italy	2,200	13,000	-
Japan	10,100[2]	120,000[4]	-
Netherlands	600[5]	-	-
Norway	300	8,000	-
Sweden	1,100	20-30,000	-
Switzerland	500	5,000	10,000
United Kingdom	12,000[2, 6]	57,000[6]	234,000[6]
			434,000
United States	185,000[2]	820,000	2,425,000

1. For Canada the following "guesstimates" are available.

Terminal Type	1970/71	1975	1980
Telex	21,000	35,600	60,000
TWX	4,000	9,000	20,000
Other Data	25,000	78,800	230,000
Totals	50,000	123,400	310,000

These figures do not include touch-tone telephones (information received from the Canadian DOC, 17th February 1972.

2. The figures for France, Germany, Japan, the United Kingdom and the United States represent data terminals, i.e. connections or interfaces with common carrier transmission services irrespective of the actual number of connections. Correspondingly the quantification in terms of modems or data-sets identifies data-transmission users on the analogue network, but not the number of terminals connected to one data-set or modem.
3. Source: COPEC, Comité du VIème Plan 1970, pp. 3-4; all other figures are based on an OECD questionnaire.
4. For Fiscal Year 1977.
5. The answer to the OECD questionnaire from the Netherlands did not give forecasts; instead it contained figures of recent developments:

1st January 1967	7 modems
1st January 1968	20 modems
1st January 1969	154 modems
1st January 1970	350 modems
12th January 1971	600 modems

6. Figures for the United Kingdom refer to the years 1973, 1978 and 1983.

200 and 600/1200 bits per second and on the leased lines the following bits per second service can be obtained 200, 600, 1,200, 2,400, 4,800. At present, the Post Office is installing a common user data network (message switching) to provide a variety of services for nationwide data processing services.

Canada: In order to achieve the most rapid expansion of computer/telecommunication systems and services, the Canadian Department of Communications has commissioned a task force to investigate the whole question of computer/telecommunications interaction.* With respect to concrete network plans to provide economically and technically appropriate high-quality telephone, radio, TV and data-transmission communications, Canada has developed a satellite systems plan. The first satellite, "Anik", which will be the world's first geo-stationary domestic satellite, is expected to provide services in 1972.**

Belgium: The Belgian T.T. administration is convinced that the annual growth rate for digital data transmission between now and 1980 will be 60%. To satisfy this demand it has planned the following telecommunications services:***

- improvement of the telex network for speeds to 200 baud during 1971;
- semi-electronic telex switching centres to be established in early 1972 and in 1975-76 a switched network of the telegraph type to be operating at 1,200, 2,400, 4,800 and 9,600 bits per second;
- with improvement of the switched telephone network (semi-electronic switching centres are envisaged) data transmission rates of 2,400 bits/sec and 4,800 bits/sec are planned by 1975-76.

France: According to the guidelines of the Sixth Plan**** the French P&T administration will try to solve both telephone and digital data communication problems by providing two alternatives on a switched basis for data transmission:

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* Canadian Telecommission Study, 5(a)(c)(d)(e), 1971, p. 32.

** Canada's satellite programme enjoyed the support of the United States government. However, it is worthwhile noting that the Canadians have also succeeded in participating in the domestic electronic-components industry as a supplier, with a much higher rate than, for example, the Europeans in the Intelsat IV series.

*** OECD questionnaire.

**** COPEC, Comité du VIème Plan, Groupe "Transmission des données, 1970, p. 5.

- The "Caducée" Network - a dedicated network for digital data transmission is in operation since January 1972. It is designed for about 2,000 subscribers and will start by allowing 2,400 bits per second and later, 4,800 bits per second. Caducée is looked upon as a transitory solution which will merge with the Hermes and Plato Projects (PCM Network) during the Seventh Plan (1976-1981).
- The 200 band telex network, which has been re-opened, is expected to satisfy low-speed data services and time-sharing clients.

Germany: The German Bundespost is planning a dedicated switched public network with a transmission speed of 48,000 bits per second. It is expected to be in operation in 1973. Additionally German telecommunication authorities are in the process of improving and replacing the existing telex network TW 39* through the new EDS (Electronic Data Switching) system. It uses high-speed computer-controlled switching of channels and gives terminal users a choice of 2,400, 4,800 or 9,600 bits/sec. The network (which will be introduced during 1973-76) is also capable of store-and-forward functions. With regard to the computer utility concept - in the narrowest sense of offering computer power - the German administration owns a 40% share of Datel GmbH.**

Italy: The Ministry of Posts and Telecommunications is responsible for telecommunications services. However, the Government has granted part of these services to common carriers such as SIP, which operates part of the national telephone service, and ITALCABLE which operates the inter-continental telecommunications services. The Italian telecommunications authorities are planning improvements of existing data transmission facilities, with the final goal of setting up a public switched integrated network.

As a first step they plan to introduce in the existing switched telephone network some "special groups" of customers having access to four-wire connections. A second step will be the introduction of advanced-technique switching equipments for the special groups, in order to obtain reduced set-up time and lower error rate.

At this stage they also envisage the availability of other services such as message switching, multi-address calls, abbreviated dialling and hot-line. The introduction of PCM systems connected to switching centres using TDM techniques will gradually lead to the setting up of an integrated digital network which is expected to cover a transmission rate spectrum of between 200 bits/sec and many hundreds of M bits/sec. In the years from 1975 to 1980 they expect gradually to begin the introduction of TDM switching centres connected with PCM links.

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* The telex network introduced in 1939.

** A private company of legally "limited responsibilities". The other shares are equally distributed among SIEMENS A.G. AEG - Telefunken and Nixdorf, (German hardware manufacturers).

Japan: In 1949, in order to allow early reconstruction and development of telecommunication services, Japan separated postal and telecommunication services. Under supervision of the Ministry of Posts and Telecommunications two companies were granted a franchised monopoly position: Nippon Telegraph and Telephone Public Corporation (NTT), responsible for domestic telecommunications services, and Kikusai Denshin Denua Company Ltd. (KDD), responsible for international services. With a consensus of national concern, the Ministry of Posts and Telecommunications made a fundamental revision of the Public Telecommunications Law in 1971, approving wider uses of the telephone or telex networks and leased lines for computer/communications systems as well as new entry of common carriers, NTT, and KDD, into the teleprocessing field. In the domestic network, NTT is now offering data transmission services with speeds of up to 2,400 bits/sec. NTT is also planning a general programme as follows:

- by 1973: establishing the public telephone network for extensive use of 2,400 bits/sec, leased line for 4,800 bits/sec and also a high-speed switching network for 48 k bits/sec by using the electronic telephone switch, D-10;
- by 1980: realizing the concept of a total network, which serves for voice, data and video simultaneously, with wave guide and electronic switch systems, when some 5,000 on-line real time systems will be in full use under the long-term development plan of NTT.

Netherlands: In addition to the normal telephone and telegraph services the Netherlands plans to inaugurate PCM transmission by 1975, offering the opportunity for 64 KBPS digital circuits. By 1978, plans call for integration of data and telephone services into one digital telecommunications TDM/PCM switched public network.*

Sweden: The Swedish Telecommunications Administration is planning a digital network for data communication. A preliminary version of the network will be in operation by 1974-75. The present plans call for completion of the full network by 1978-79. The speed characteristics will be those standardized by the CCITT. The telephone and telex networks will have access to the full network.

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* Information from J.M. van Oorschot, directeur Rijkskantoormachinecentrale, The Hague, 12th January 1972.

The United Kingdom: The United Kingdom Post Office foresees, for the next ten years, continued extension and development of its Datel services, based on adaptations, through modems, of present types of telephone services in the form of leased circuits and private networks as well as using switched public telephone connections. In addition, plans are being prepared for a digital data network to come into operation from 1977, giving circuit-switched services and capable of being integrated with future telephone systems using synchronous digital transmission and switching. The circuit-switched data services are expected to include customers' speeds of up to 600 bits/sec (including telex), and isochronous speeds of 2.4 k bit/sec, 9.6 k bit/sec, and 48 k bit/sec.

A packet-switched service may be added at a date to be determined if it is shown to be technically and economically attractive. The Post Office has offered to establish in 1974 an experimental packet switched service so as to determine jointly with its customers the practicability of this mode of working.

The United States: In the United States developments have been much more rapid; they include:

- Initiation, in January 1970, of a two-year experimental programme involving the Post Office and the Western Union Telegraph Company. This permits Western Union's INFO-COM and Telex subscribers in twelve cities to send "mail-grams" via a computer to teleprinters in any of 110 participating post offices for delivery the following morning.* With respect to the ever-increasing deficit in postal letter delivery, a recent General Electric proposal is interesting.** It estimates the cost of a 600-word message at ten United States cents.***
- Rapid growth of AT and T metropolitan PCM facilities utilising T. 1 digital carrier systems. The 1,544 megabit/sec data stream now serves virtually all metropolitan areas and involves some thirteen million channel miles. In addition, AT and T has these plans for the near future.****

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* A Preliminary Survey of Data Communications in the United States, edited by John M. Richardson and Robert Gary, Office of Telecommunications, United States Department of Commerce, OECD Doc.

** Telecommission Study 7(i), Postal Services and Telecommunications, Canada, Department of Communications, 1971, p. 14.

*** See also the FITCE Report.

**** Bell announcement: Datamation, 15th September 1971, p. 46.

  - for 1972, a new digital system operating at 6.3 megabits per second;
  - by 1975, initiation of private line service on an end-to-end fully digital basis, serving every major city in the United States;
  - by the late 1970s, waveguide systems capable of thousands of megabits per second.
- Development and partial completion of sophisticated government digital networks such as Autidon, the GSA advanced record system, the NASA deep space tracking network and the national crime information system.*
- Introduction of commercial picturephone service in July 1970, incorporating a digital intercity network, which also provides high-speed computer communications at 460.8 kilobits/sec.**
- Successful demonstration of the ARPA network. This Advanced Research Project Agency network interlinks some fourteen service complexes sharing such resources as hardware, software and data files.***
- Some 1,800 applicants for establishing new, specialized independent data carriers. These proposals are currently under study by the Federal Communications Commission. There is a strong possibility that Microwave Communications Inc. (MCI) and Datran could become regulated specialized carriers in competition with AT and T.

The European Communities: An interesting example of a supranational effort is the project COST 11 to build a European Computer Network.**** This technical development agreement to favour the European Co-operation in the field of Scientific and Technical Research (COST) was initiated by some European countries. This network is geared to meet the following three main functions:

1. to facilitate the exchange of ideas between the computer centres which it links, and associated centres and the development of co-ordinated research programmes;

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* See Richardson, John M., OECD Survey p. 32 ff.

** For 1975 AT and T expects 50,000 picturephones in service, AT and T Annual Report 1970, p. 8.

*** The following are interconnected: University of Illinois, University of Utah, University of California at Los Angeles, University of California at Santa Barbara, Harvard, MIT, Mitre Corp., Stanford Research Institute and the Rand Corp.

**** Agreement on the establishment of a European Informatics Network, COST/13e/72 PB/cjb - EEC/EURATOM/ECSC, Brussels, 28th February 1972, COST/13/72.

2. to provide a forum for the discussion and comparison of schemes now being proposed for national networks, and to promote the definition of European standards for the exchange of information between computers;

3. to provide a potential model for future networks, whether for commercial or other purposes, and to minimize incompatibilities between data processing systems now at the planning stage.

In its initial stage the network probably will interlink the following centres:

- National Physical Laboratories
  Teddington, U.K.,
- Institut pour la recherche informatique et automatique (IRIA)
  Roquencourt, France,
- Politechnicum Zürich
  Zürich, Switzerland,
- Politechnico of Milan
  Milan, Italy,
- Common Research Centre of Euratom
  Ispra, Italy.

Chapter 9

MARKET ENTRY ISSUES

9.1 INTRODUCTION

The previous considerations have made it clear that there is a natural alliance between computers and telecommunications. Since 1965 computer and telecommunications industries have begun to converge in the sense that:

- each has become dependent upon the facilities and services of the other;
- each has tried to enter the markets of the other.

These developments, of varying urgency in different Member countries, encompass several intriguing policy issues.

They lead to the question of whether telecommunications carriers should be allowed to enter the competitive data processing market and, by contrast, whether EDP industries, (i.e. manufacturers, hybrid service bureaux, banks, etc.), should enter the regulated, monopolistic telecommunications field.

The public interest in solving these associated market-entry policy issues becomes evident on closer acquaintance with latent market-entry candidates. Some of the communications carriers occupy monopoly positions (Postal and Telecommunications Administrations) or are subject to direct control (AT and T). Other firms, such as banks, are subject to government supervision, but are not regulated per se. The computer industry, given the position of IBM, operates as a monopoly or loose oligopoly (depending on one's viewpoint). Finally, there is the service bureau industry, which represents rivalry or working competition to both the others.

Assuming the economic power of these candidates for market-entry can be channelled so as to exploit optimum possibilities of computer telecommunications systems, public policy is simultaneously presented with both an opportunity and a burden.

9.2 DIVERSIFICATION ISSUES

Whereas the discussion on shaping the future structure, and thus the quality of the future key-market, is carried on at very sophisticated levels in a few countries, in most of OECD countries two trends stand out:

- the interest of EDP system users in allowing the development of private networks;*
- concerning the question of whether and how the carrier should or could offer data-processing services in those Member countries where telecommunications are provided by government sources, it is believed they could be used as an important means of providing a vast and rapid proliferation of computer power and services.

Consequently, Manley Irwin has argued that carrier entry has been discussed in terms of method rather than desirability. He has introduced an alternative discussion pattern based on actual trends: the horizontal and the vertical approach. **

9.2.1 The horizontal approach

This enables the common carrier to offer on-line data processing services, i.e., computer power and/or application services. The question is still to be solved whether according to this approach, the carrier would offer EDP services on a:

- tariff or regulated basis, or
- non-tariff or non-regulated basis.

9.2.2 The vertical approach

With the vertical approach carriers establish an EDP affiliate separate and apart from the regulated parent.

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* Thus, the International Chamber of Commerce has advocated private customer networks within the context of the CCITT.

** Irwin, Manley R., Multiple Access Computer Networks, The Role of the Common Carrier, 1971.

Through the prohibition of sharing financial, technical and management resources, this approach would theoretically reduce the danger of unfair competition with private on-line service bureaux. In addition, it is anticipated that the following safeguards would be considered:

- prohibition of cross-subsidization from revenues arising from different activities of the carriers, (i.e., lucrative telephone services to offset deficits in online computer services caused by an agressive marketing policy to drive out competitors);
- prohibition of preferential tariff treatment, (i.e., granting certain groups cost-based tariffs, as distinct from the commercial tariffs offered to the public);
- prohibition of disclosure of proprietary information to the affiliate which the parent carrier may have
    - concerning possible competitors of the affiliate;
    - concerning all kinds of planning activities of the parent company in telecommunications.

The latter is specifically mentioned in the Act allowing the British Post Office to sell data-processing services. The Post Office (Data Processing Service) Act of 1967 forbids the exchange of information concerning planned activities between members of the NDPS Board and the Post Office, unless it is available to "all parties concerned".

9.3 ARGUMENTS AND ALTERNATIVES IN THE ENTRY ISSUE

In the absence of detailed information some of the arguments for and against common participation in data-processing services can only be summarized.

9.3.1 Arguments for carrier participation

Resources available to the carriers: There is a general belief that full exploitation of computer telecommunications possibilities will require heavy expenditure and mobilization of many resources. The telecommunications carriers, either regulated or exercising a monopoly, command technical knowledge, experience and adequate financial resources.

Common use of equipment and optimum system design: To offer public data-processing, and in particular raw computer power, it has been claimed, would facilitate more efficient use of total plant facilities and the development of an optimum system design for a national computer utility network. This again might well reduce costs of both computer and communication services.

National objectives: The fact that the "natural monopoly" concept in telecommunications involves obligations may ensure the provision of data-processing services even to small users and remote and underdeveloped regions of Member countries. As these services are not profitable per se it is argued that they might be unavailable in a competitive, free enterprise-oriented carrier system.

Public concept as a stimulus to EDP application growth: The existence of computer utility networks, including the offer of raw computer power by telecommunications carriers as well as others, such as independent service retailers described earlier in this report, might lead to the rapid growth of an unregulated EDP application service industry. This again could facilitate the development of a new class of entrepreneurs, particularly since in many cases large capital investment is not required and competition here is clearly in the public interest.

Restraint on undesirable practices: Large EDP manufacturers, due to their monopolistic situation, did establish some undesirable practices concerning programmes and exchange of know-how between customers and manufacturers. Common carriers, powerful purchasers of EDP systems and themselves among the largest companies in every Member country, could exploit their powerful bargaining power. Thus, improved market forces could exclude any undesirable practices which manufacturers seek to impose.

9.3.2 Arguments against carrier participation

Unfair competition for existing data processing companies: Many independent small data-processing companies in various countries are undergoing a period of readjustment. If the telecommunication carrier entered this highly competitive, unregulated market and operated with a monopolistic philosophy, this could lead to unfair competition. In the long run small companies would be forced out of the market, which could lead to poorer services.

Cross-subsidization and preferential treatment: Particularly in a case where data-processing services are offered horizontally, i.e., integrated with telecommunications services, the carrier's monopoly position is much feared by its opponents, who argue that:

- small data-processing companies (small when compared with carriers in terms of technical, managerial and

- financial resources) would be at a disadvantage in bargaining with the carrier for physical communication links and services;
- if the communication carrier were permitted to offer data-processing services in an unregulated manner, these could be subsidized from traditional telecommunications service revenues, which could prove harmful in two ways: first, charges to telecommunications users would be artificially inflated and, second, carriers would be in a position to exercise unfair competition by cutting prices below those of data-processing competitors.

Even if the vertical approach were guaranteed, opponents claim there would still be many forms of preferential treatment for the quasi-autonomous affiliate and thus discrimination against free enterprise service companies.

The preferential treatment could manifest itself by:

- early delivery of new equipment through bulk ordering, advance notice of price and service charges, superior maintenance service;
- particular attention to the needs and the competitive position of the affiliated "daughter" company when considering whether to offer new services, the schedule for their introduction and the place or areas where they should be made available;
- the disclosure of proprietary information and development plans of the carrier itself and/or competitors, obtained through arrangements made by them with the carrier.

Obstacles to effective regulation: Even closer to the mark is the argument of opponents to carrier participation that regulation of the common carrier as exercised, for example, by the Federal Communications Commission for preventing cross-subsidization has already been unsatisfactory with traditional telecommunications services. Consequently, they argue, the allocation of joint costs within a horizontally integrated concept, where the carrier offers raw computer power, traditional communications services (telephone, telex, etc.), EDP application services, and (as with some European administrations) even non-coherent services, such as postal services, will become impossible.

It is even doubted whether the vertical diversification solution for offering data-processing through a subsidiary plant could solve the allocation of joint costs, given the present market structure and common carrier equipment-supplier relationship.

Slow innovation by carriers: A further argument against common carrier market entry is that common carriers are slow to innovate and introduce new techniques and facilities. The rate of innovation is limited by the need for adapting new systems into equipment already installed.

Since depreciation rates for telecommunications administrations and regulated utilities are keyed to the technical life of equipment - as distinct from its economic life - the rate of innovation, and thus investment decisions involving the impending availability of new technologies, is limited to the depreciation pattern now applied.

In addition, it is argued that the needs of the computer utility industry demand modification of traditional tariffs, practices and customs, which were designed to satisfy the requirements of voice transmission, itself an object for complaint. Thus, the French Telecommunications Minister has proclaimed the unsatisfying situation in the common carriers' domain of the telephone as a "result of late and slow adaptation of structures and mentalities".*

Dilution of telecommunications: The exploitation of recent technological developments which promise enormous improvements in the quality and versatility of telecommunications services would require most of the financial, technical and management resources of the carrier. As these resources are limited, for political as well as economic reasons, there is a danger that the diversification solution might lead to a dilution of the common carriers' primary telecommunications obligation: to provide the public with telephone and related services with adequate facilities at reasonable charges.

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* Translated from the introduction to: Travaux et recherches de prospective, Schéma général d'aménagement de la France, Eléments pour un schéma directeur des télécommunications, Paris, 1970.

Chapter 10

ECONOMIC PLANNING AND POLICY CONSIDERATIONS

10.1 INTRODUCTION

Despite the obvious importance of technical and economic factors in the development of computer telecommunication policies, there is no standard analysis. This is true of the computer and related industries, terminal, telecommunication and software-consultancy industries, as well as common carriers, which enjoy a monopoly in most OECD countries for telecommunication and thus bear a tremendous responsibility. This is not only a theoretical responsibility. Because of their size, whether measured in manpower or turnover, they represent a considerable economic power both as a demander of services, goods, financial resources and manpower and as a supplier of services for the market. Thus, if common carriers could exercise a vital ordering function they could give guidance to the future-oriented computer telecommunication industry which experts consider at the moment to be characterized by chaos, insofar as standards and futur applications are concerned.

One of the main difficulties - that of assessing and anticipating the state of the electronic mass-communications-media industry in 1980 and after - is the fact that the current industry is comparatively in its infancy.

Consequently, the following remarks are but a starting point for a comprehensive study.

10.2 THE DATA PROCESSING INDUSTRY

At the end of 1970 the world-wide population of computers exceeded 70,000 and the cumulative investment in hardware, software and manpower approached $ 100 billion,* 90% of which is generally accounted to developments in the United States. Table 21 provides a survey of the distribution of computer systems in OECD countries.

Table 21. COMPUTER SYSTEMS GROWTH, 1970-1974

(EDP Hardware)

	MARKET SIZE FORECASTS ($ MILLIONS)		AVERAGE ANNUAL GROWTH RATE %
	1970	1974	
Japan	930	2,213	28.5
Germany	568	1,150	19.3
France	418	896	21.0
United Kingdom	405	970	24.3
Canada	175	360	19.8
Italy	112	231	19.9
Sweden	66	134	19.4
Netherlands	45	79	15.1
Belgium	38	91	24.3
Denmark	33	66	19.0
Spain	32	67	20.5
Switzerland	28	57	19.4
Yugoslavia	20	46	23.5
Norway	12	25	20.4
Finland	11	21	17.5
Austria	5	9	15.8
Total	2,887	6,656	23.5

SOURCE: Estimates contained in AFIPS Report, Statistical Research Programme, January 1971, pp. 2 and 13.

10.3 GROWTH PROJECTIONS

Although historical, economic and technological forecasts are inevitably subject to sensible criticism, these approaches might be considered:

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* Forecasts, 1971, by I.L. Auerbach in Proceedings of IFIP's Conference Papers, p. 236.

10.3.1 Historical extrapolation approach

In this approach, the historical pattern of investment is computed from available data and extrapolated into the future. Thus in a study prepared for the Canadian Department of Communications, a growth rate of 20% for telecommunications-based computer systems was compounded annually and extrapolated to 1980. Assuming the average cost of these computer systems - some 2,700 in 1970 - to be $ 430,000, the forecast arrived at 15,000 systems in 1980, or a total investment of $ 5 billion. *

10.3.2 Transaction approach

This is a new approach for assessing the growth of the telecommunication-based computer industry and evaluating telecommunication requirements. It is used in network planning by the Canadian Telecommunications Department** and by Datran.

A Canadian approach

The Canadian study first defines a "transaction" and then considers the numbers of transactions which might be involved in a variety of different computer utility applications. Typical transactions include: making a reservation, asking for a stock quotation, transferring credits from one account to another, etc. Knowing the number of transactions and the rate at which they may be handled, it becomes possible, Canadian experts believe, to calculate computer and telecommunication requirements. Their study concludes that expected capital investment for all systems likely to be implemented in Canada by 1980 will be about $ 2.3 billion (if growth depends on normal market forces) and $ 6.3 billion (if the government takes steps to stimulate the industry).

The Datran Proposal

The Datran transaction approach is especially worthy, because its projections of investment for telecommunication systems are not based on costs of systems today, but on the likelihood of decreasing costs due to new technologies and greater competition. (Earlier in our report it was stated that decreasing system costs would be possible through new technologies, such as LSI and large scale production.) The Datran approach therefore seems more appropriate for coping with dynamic development in computers and telecommunications and

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* "Trans-Canada Telephone System Telecommission Computer Study", in Telecommission Study 5(a), p. 38.

** Telecommission Study 5(a), 1971, p. 41.

incorporating the mutual interdependence of the economic and technological parameters involved. Additionally Datran's analysis is more user-oriented, evaluating the most likely application segments of the American economy. Tables 22-29 reveal Datran's elements in planning for a separate digital telecommunications network:

Table 22. DATA TRAFFIC FORECAST
FOR THE UNITED STATES

REFERENCE	1970	1974	1980
Number of transactions (billions)	14	50	250
Number of calls[1] (billions)	3.7	12	32
Number of data terminals (thousands)	185	800	2,500
Number of termination points (thousands)	84	310	1,000

1. SOURCE: Datran Report, p. 1. (Excerpts from a major market research study conducted for Data Transmission Company.)

10.3.3 Comparison of expected expenditures

In 1970 there were some 63,000 computers installed in the United States - 2.5 machines per 10,000 population. Table 21, which does not show the most important characteristic, such as small, medium and large systems, indicates the situation in selected Member countries.

With respect to future development in the United States, it is predicted that the United States will spend $ 260 billion* before 1980 to build and expand data-processing and telecommunications systems. **

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* Business Week, 6th December 1969.

** This projection is emphasized by the United States Presidential Science Adviser, Edw. E. David, Jr., in a recent interview, "...we are particularly interested in seeing the (Data-processing) industry prosper...". This has led to the addition of another $ 100 million to the fy-'72 budget of the NSF (National Science Foundation). See Datamation, 15th September 1971.

Table 23. GROWTH OF REMOTE DATA TERMINALS BY ECONOMIC SEGMENTS IN THE UNITED STATES

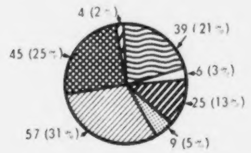
ECONOMIC SEGMENT	FORECASTED NUMBER OF REMOTE DATA TERMINALS (THOUSANDS)			COMPOUNDED ANNUAL GROWTH RATE %	
	1970	1975	1980	1970-1974	1974-1980
Securities	39	50	70	7	4
Insurance	6	25	70	41	18
Manufacturing	25	40	70	13	9
Retailing	9	90	380	78	27
Banking and Finance	57	375	1,000	60	16
Information Services	45	200	800	46	26
Health Care	4	20	110	50	33
All	185	800	2,500	45	21

SOURCE: Datran Report.

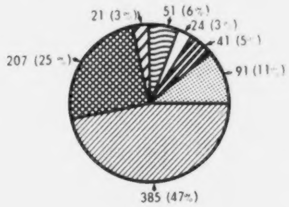
Table 24

FORECASTED NUMBER OF REMOTE DATA TERMINALS BY ECONOMIC SEGMENT

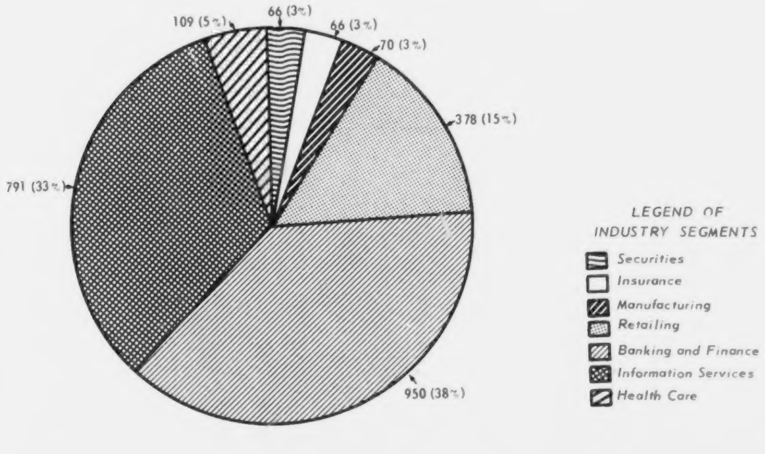
1970 - TOTAL NUMBER OF DATA TERMINALS - 185,000*



1974 - TOTAL NUMBER OF DATA TERMINALS - 820,000*



1980 - TOTAL NUMBER OF DATA TERMINALS - 2,425,000*



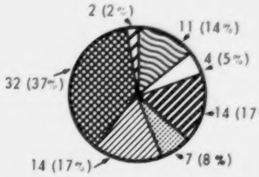
* Totals on summary tables may differ slightly due to rounding.

Source : Data Transmission Company.

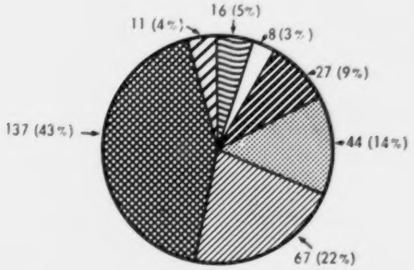
Table 25

FORECASTED NUMBER OF TERMINATION POINTS BY ECONOMIC SEGMENT

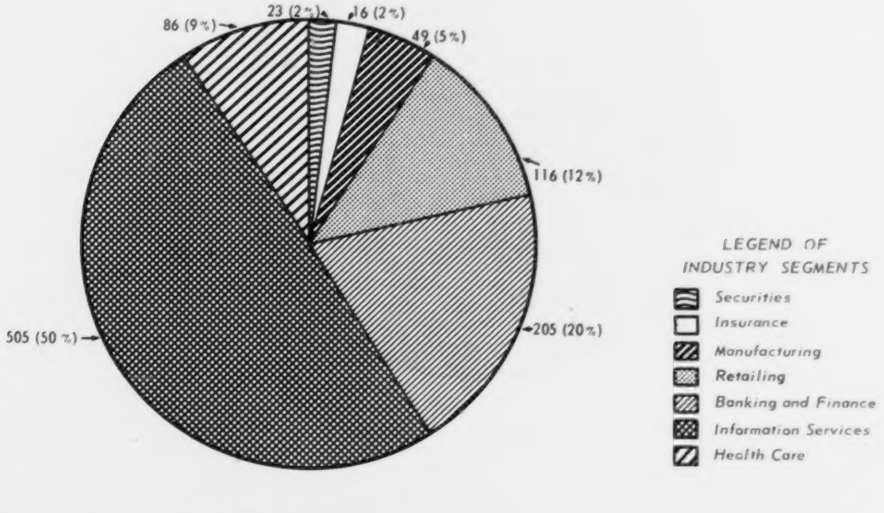
1970 - TOTAL NUMBER OF TERMINATION POINTS 84,000



1974 - TOTAL NUMBER OF TERMINATION POINTS 310,000



1980 - TOTAL NUMBER OF TERMINATION POINTS = 1,000,000

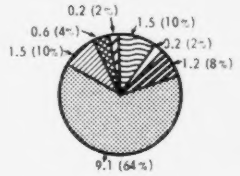


Source: Data Transmission Comp.

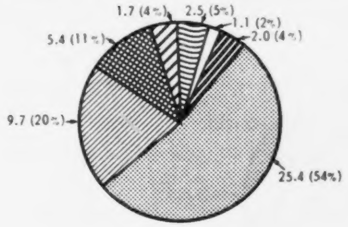
Table 26

FORECASTED TRANSACTION VOLUME BY ECONOMIC SEGMENT

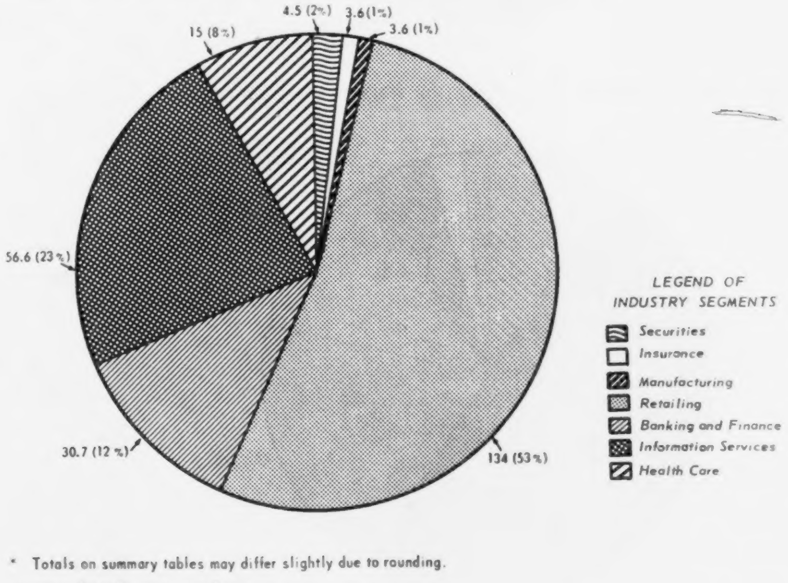
1970 - TOTAL VOLUME 14.3* BILLION TRANSACTIONS



1974 - TOTAL VOLUME 47.8* BILLION TRANSACTIONS



1980 - TOTAL VOLUME 248* BILLION TRANSACTIONS



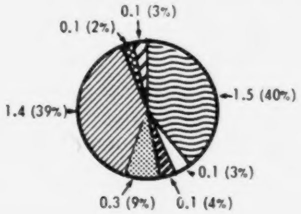
* Totals on summary tables may differ slightly due to rounding.

Source : Data Transmission Comp.

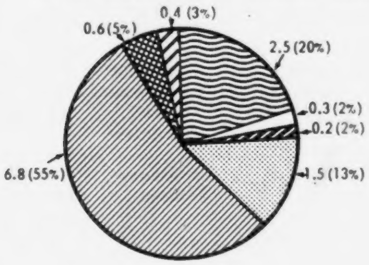
Table 27

FORECASTED CALL VOLUME BY ECONOMIC SEGMENT (USA)

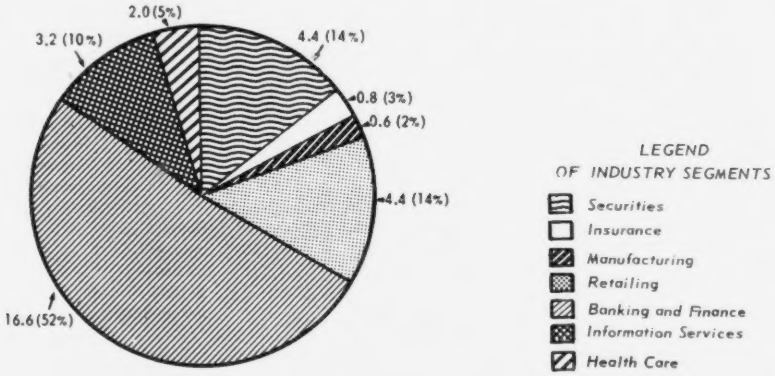
1970 - TOTAL VOLUME 3.7 BILLION CALLS



1974 - TOTAL VOLUME 12.4 BILLION CALLS



1980 - TOTAL VOLUME = 32 BILLION CALLS



Source : Data Transmission Comp

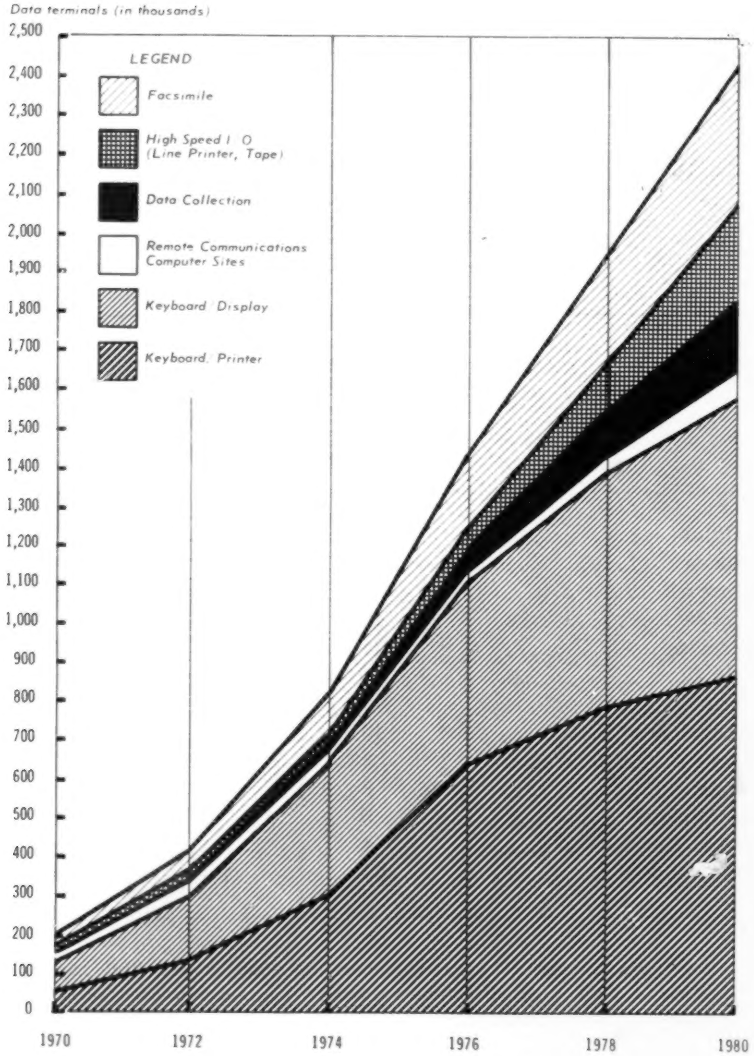
Table 28. MAJOR DATA COMMUNICATIONS APPLICATIONS AND THE LEVEL OF TELECOMMUNICATION-SOPHISTICATION IN SEVEN UNITED STATES' INDUSTRIES

ECONOMIC SEGMENT	FORECASTED FUTURE LEVEL OF EDP TELECOMMUNICATION SOPHISTICATION	APPLICATION AREA			
		FINANCE/ ACCOUNTING	MARKETING/ SALES	OPERATIONS	DISTRIBUTION AND OTHER
Securities	High	Branch cash and securities movement	Order matching Quotes	Cage operations Customer inquiries	Investment analysis
Insurance	Modest	Claims Premium Payments	New policies	Status inquiries Premium-transactions	
Manufacturing	Modest	Payroll Cash management	Order quotes and processing	Production and inventory control OR models	Engineering Warehousing Shipping
Retailing	High		Point of sale Credit authorizations Recorders	Inventory control	Fuel terminals Warehousing
Banking and Finance	High	Lock-box and other corporate services Interbank transfers		Teller operations Consumer finance branches Bankcard authorizations	Automated banking services
Information Services	High				Timesharing Remote batch processing Facsimile Information retrieval
Health Care	High	Pharmacy, physician and Hospital claims Patient accounting		Hospital operations Lab tests Patient monitoring	

SOURCE: Datran Report.

Table 29

FORECASTED NUMBER OF REMOTE DATA TERMINALS
BY TYPE OF DEVICE (USA)



Source : Data Transmission Company.

Of this total, capital expenditure for telecommunications alone will be at least $ 100 billion. The remaining $ 160 billion might be required for computer systems and services.

Thus, if national economies are merely to maintain the present position vis-à-vis the United States, tremendous financial resources are needed. Table 30 may give some idea of the order of magnitude of resources required, if this policy is to be applied (without taking into account the geographical, demographical and economic conditions in the various countries).

Table 30. EXPECTED EXPENDITURES FOR COMPUTER-TELECOMMUNICATION SYSTEMS, 1970-1980[1]

(Estimated in 1970 prices)

COUNTRY	FOR DIGITAL COMPUTER SYSTEMS (BILLION $)	FOR DIGITAL TELECOMMUNICATION SYSTEMS (BILLION $)	TOTAL (BILLION $)
Belgium	8	5	13
Canada	16	10	26
Denmark	4	3	7
France	40	25	65
Germany	48	30	78
Italy	44	27	71
Japan	80	51	131
Netherlands	10	7	17
Norway	3	2	5
Sweden	6	4	10
Switzerland	5	3	8
United Kingdom	44	28	72
United States	160	100	260

1. The figures have been calculated as follows: The United States is likely to spend $ 100 billion for digital telecommunication systems. Thus, a corresponding amount for any country could be calculated:

$$\frac{\text{Population of country A}}{\text{Population of the United States}} \times \$\,100 \text{ billion.}$$

Expected American investment expenditures 1970-1980 compared with other national plans for improving data-transmission facilities:

	In millions	
Germany	DM.	375*
Japan**		
Sweden	$	50***
United Kingdom	£	53****
United States	$	100,000

Table 31 compares investment expenditures for digital computer and telecommunications systems, if the United States forecast is applied, with present plans in four Member countries.

10.3.4 Utilization-oriented approach

In order to prevent possible disastrous developments in basic telecommunications network planning by assuming too "narrow" a speed basis, telecommunications-based information retrieval and processing systems should be thoroughly investigated from the utilization aspect.

The questions should be posed in the following way: what kind of applications are most likely to be requested in the near future, or desired for public service? Subsequently: what bit-stream capacities are needed for the telecommunication channels to operate and use such systems remotely (as distinct from the common approach: here are some channel capacities - what applications can be realized with them)?

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* The German Bundespost will need some DM 375 millions for introducing a projected EDS system (1973-76). It is expected that the improvement of switching will bring tremendous savings; as the existing network can be better "used" (alternative routing, etc.) no financial resources for expanding it will be necessary in the following five years.

** Nippon Telephone and Telegraph (NTT) has announced an investment plan for digital data-transmission facilities of $ 600 millions over the next four years. It is expected to increase this sum to $ 10 billion by 1977.
Jacques Montagnes, "Panorama japonais", L'Informatique, July, 1970, p. 77.

*** OECD Document.

**** The British Post Office Corporation is prepared to spend some £ 53 million for digital telecommunications. See Reference Q1806, "Report of the Sub-Committee on Science and Technology", Stanley Gill, "Telecommunications and the Computer Industry", in British Computers and Industrial Innovation, 1971, p. 53.

Table 31. COMPARATIVE EXPENDITURE PLANS FOR COMPUTER/TELECOMMUNICATION SYSTEMS

	FOR COMPUTER SYSTEMS		FOR TELECOMMUNICATIONS	
	IF US FORECAST IS APPLIED	PRESENT INVESTMENT PROGRAMME	IF US FORECAST IS APPLIED	PRESENT INVESTMENT PROGRAMME
Germany	24 (by 1975)	0.7 (1971-1975)[1]	18 (by 1976)	0.1 (1973-1976)
Japan	25.1 (1971-1975)	9.7	40	0.6 (1971-1975)
Sweden	3 (by 1975)	n.a.	2	0.05 (by 1975)
United Kingdom	22 (by 1975)	n.a.	16.5 (by 1976)	0.148 (by 1976)

[1] The Second EDP Promotion-programme of the German government has provided some DM. 2.4 billion for the period 1971-1975, for:

Universities (Including EDP Centres)	757.9 Mill. DM.
Manpower-Education	162 Mill. DM.
D.P. Utilization	558 Mill. DM.
Research with manufacturers	705 Mill. DM.
Special programmes	240 Mill. DM.

SOURCE: Der Bundesminister für Bildung und Wissenschaft, Pressemitteilungen, 97/71, Bonn, 3rd November 1971.

Unfortunately it appears that different philosophies have developed in Europe and the United States with regard to the definition of low, medium and high speeds:

Table 32. NETWORK PERFORMANCE CHARACTERISTICS

COUNTRY	LOW SPEED	MEDIUM SPEED	HIGH SPEED
Western Europe[1]	200 bits per second and below	201 bits per second to 10,000 bits/second	above 10,000 bits per second
United States[2]	50,000 bits per second	7 Megabits per second	50 Megabits per second

1. United Kingdom answer to questionnaire applies to most Western European countries.
2. President's Task Force on Communications Policy, Staff Paper 1, Part 2, 1969, p. 4.

Since an analysis of possible telecommunications-based computer applications and their network requirements is outside the province of this report, only certain characteristics have been considered.*

10.3.5 Data terminal approach

Forecast of data terminal figures

The data terminal approach is an attempt to assess the future development of the computer-utility concept by quantifying the possible number of users of the system. It seems the most satisfactory approach for evaluating future telecommunications requirements. Forward planning based on these terminal forecasts (see Table 20) is more debatable; it is in forward planning that shortcomings may be most serious.

The absolute figures for data terminals of OECD countries included in Table 20 look quite promising. They look less so, however, when viewed in conjunction with the number of people for whom they are planned.

* An excellent approach to analysing computer and telecommunications requirements in terms of sophisticated application may be found in: The New Land Data Bank in Sweden, by Helmer Wallner, Director of the Swedish Central Board for Real Estate Data, Finifa.

Tables 33-35 show how many inhabitants and civil employees will have to share a terminal by 1980. The figures in these tables - owing to lack of other data - are compared with the number of telephone sets per 100 inhabitants and civil employees for illustration purpose only. However, if expert opinion is correct that by 1980 data terminals connected to computers and data bases will be as common as the telephone today, then market estimates of these common carriers are very conservative.

There is good reason to believe that this approach is too "small" particularly:

- with respect to potential applications and users of telecommunications-based computer systems;
- with regard to the social context; if access to information and its manipulation capabilities is reserved for a privileged class only (see Tables 33-35) it could lead to severe social unrest;
- in view of industrial considerations; such a small number of systems and input/output devices will fail to allow large-scale production leading to economies of scale and possibly low unit (terminal) costs.

Philosophy of speed

Experts seem most worried by the question of transmission speed, which underlies the planning parameters of most telecommunication authorities. A key question for an on-line real-time telecommunications-based application is the transmission speed measured in bits per second allowed by the telecommunication link. Thus it is decided within the network which remote applications are possible and which are not.

Unfortunately, a dogma has developed as to the speeds necessary in a public switched network for the next 10-15 years. There were no sophisticated applications considered in the planning, but respective telecommunications authorities believe (and used as planning parameters) "that 85% to 97% of all data transmission applications will only need low or medium transmission speeds, i.e. 2,400 bits and below"* by 1985.

Correspondingly, a British consultant's report on which the Post Office is said to rely heavily for its present planning has estimated that by 1983, 99.9% **of all data terminals likely to be installed will

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* FITCE Report, p. 44.

** Based on Data Transmission, Post Office Telecommunications, United Kingdom.

Table 33. DATA TERMINALS PER CIVIL EMPLOYEE IN SELECTED OECD COUNTRIES [1]

COUNTRY	NUMBER PER 100 CIVIL EMPLOYEES			NUMBER PER 100 CIVIL EMPLOYEES IN THE TERTIARY SECTOR		
	1970/71	1975	1980	1970/71	1975	1980
Belgium	0.01	0.1	1.3	0.2	3	27
Denmark	0.03	0.7	2	0.6	14	49
France	0.01	0.3	-	0.02	0.6	-
Germany	0.006	0.03	0.3	0.01	0.07	0.6
Italy	0.01	0.07	-	0.03	0.2	-
Japan	0.02	0.24	-	0.04	0.54	-
Netherlands	0.01	-	-	0.03	-	-
Norway	0.02	0.5	-	0.04	1.1	-
Sweden	0.02	0.5-0.7	-	0.06	1-1.5	-
Switzerland	0.02	0.2	0.4	0.04	0.4	8
United Kingdom	0.05	0.2	1-2	0.09	0.5	1.8-3.5
United States	0.2	1	3	0.4	2	5

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1. The number of reported data sets and terminals has been divided by civilian employment figures for 1969 and figures of civil employees in the tertiary service sector. For example, employment figures have been considered as constant. (OECD Observer, No. 50, February 1971.)

Table 34. INHABITANTS AND DATA TERMINALS/TELEPHONES IN SELECTED OECD COUNTRIES

COUNTRY	INHABITANTS SHARING ONE DATA TERMINAL			INHABITANTS SHARING ONE TELEPHONE 1970
	1970	1975[1]	1980[1]	
Belgium	24,115	1,929	193	5
Denmark	6,990	306	87	3
France	25,162	1,007	-	6
Germany	40,565	7,606	895	5
Italy	24,600	4,163	-	6
Japan	10,300	853	-	4
Netherlands ...	21,455	-	-	4
Norway........	12,840	481	-	4
Sweden	7,240	400-265	-	2
Switzerland	12,450	1,250	622	2
United Kingdom	4,640	976	238-130	4
United States ...	1,100	250	84	2

[1] Using population figures for 1970.

Table 35. DATA TERMINALS AND TELEPHONES PER 100 INHABITANTS IN SELECTED OECD COUNTRIES

COUNTRY	DATA TERMINALS PER 100 INHABITANTS			TELEPHONES PER 100 INHABITANTS[1] 1970
	1970	1975	1980	
Belgium	0.004	0.05	0.5	20
Denmark	0.01	0.3	1	33
France	0.004	0.1	-	16
Germany	0.002	0.01	0.1	20
Italy	0.004	0.02	-	16
Japan	0.01	0.1	-	22
Netherlands	0.005	-	-	24
Norway........	0.008	0.2	-	28
Sweden	0.02	0.3-0.4	-	54
Switzerland	0.008	0.08	0.2	45
United Kingdom	0.02	0.1	0.4-0.8	25
United States ...	0.09	0.4	1.1	56

[1] See The World's Telephones as of 1st January 1971. American Telephone and Telegraph.

operate at slow and medium transmission speeds, slow and medium being defined as up to ten thousand bit/sec.* Thus, with a switched network designed for these limited possibilities, by 1985 most of the applications using visual displays as in computer-aided-instruction and consumer information systems would be impossible.** Only "less sophisticated" terminals such as printers, would be served and Martin therefore concludes that "some European countries regard data network requirements as merely an up-grading of their present telex or other switched telegraph networks".***

This seems all the more regrettable since in most European countries all means of telecommunications, such as radio, TV and telephone, are more or less under the same government jurisdiction and thus could be much better and more easily integrated than, for example, in the United States, where these high capacity techniques of telecommunications are in private hands and some (e.g. Cable TV) are not even subject to regulation through the FCC. Consequently, the conditions for integrated use of these facilities meet many more "natural" constraints in the United States than in other Member countries.

It was earlier mentioned that these systems might help to ease time- and paper-consuming activities in the service sector. Thus, in order to realise the trend towards paperless, "instant transaction" societies, terminals then in use cannot be teleprinter devices, but rather should be ultrafast facsimile and visual display terminals permitting instant interaction. The "bit-calculation" demonstrated in the discussion of computer-aided instruction, consumer information systems, etc., showed that - abstracted from resolution techniques still to be developed - hundreds of thousands of bits have to be transported economically over the network. This refers particularly to the local-loop network. Consequently FITCE experts recommend that a switched telecommunications network with capacities of some million bits per second be envisaged.****

In this connection there is another excellent example of the interdependence of common carrier services and the system designs of related industries: the videophone. As it is now, with its very small screen (5 x 5 inches), it has merely intangible benefits and so remains a gadget. But its screen is small because telecommunications facilities offered by common carriers do not allow a TV-sized or any larger screen.

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* OECD questionnaire, 1971.

** The French Administration estimates that 99% of the data terminals operate at no higher than 10 k (thousand) bit/second speeds. See COPEP du VIème Plan, 1970, p. 3.

*** Martin, James, Future Developments in Telecommunications, p. 96.

**** FITCE Report, p. 35.

On the terminal side of the computer-utility concept, the comparative results of alternative network capabilities could be described in tabular fashion:

Table 36. THE INTERDEPENDENCE OF NETWORK PERFORMANCE AND TERMINAL CHARACTERISTICS

STATE OF THE ART OF THE TELECOMMUNICATIONS NETWORK	TERMINAL CHARACTERISTICS
Low speed	- sophisticated terminals with memory - prohibitively expensive - complicated to handle
High speed	- TV-screen interactive real-time applications - cheap terminals - widespread use (no concentration of power) - easy operation, etc.

Thus, through systematic planning efforts and in view of their considerable market power (common carriers in Member countries count among the largest enterprises in terms of manpower employed, turnover and monopolistic position), common carriers are in an excellent position to generate and implement policies needed to shape the new computer telecommunication technologies. The necessities for so shaping these technologies are:

- to maximize benefits in social, economic and technical terms (widespread use, low costs through large-scale production, etc.);
- to minimize harmful effects in terms of social goals and purposes (privacy invasion, concentration of power, etc.).

The problem of controlling these technologies and their impact is of course related to analysing their nature in order to arrive in time at methods and plans.

The alternative is to be controlled by these technologies and the interested pressure groups, a situation, most experts agree, which has generally been true of technologies up to the present.

Chapter 11

POLITICAL AND ECONOMIC CONSTRAINTS

11.1 ORGANISATION AND PERFORMANCE OF TELECOMMUNICATIONS SERVICES

In most OECD countries responsibility in the field of telecommunications has been delegated to governments and their associated agencies by constitutional law. However, in the exploitation of these responsibilities, various methods and patterns have developed leading to differing degrees of performance in terms of quality, quantity and tariffs for telecommunications services.

According to an OECD check-list, telecommunications services in Member countries are operated and/or owned by:

- government administrations - 15 countries
- government and private corporations - 5 countries
- private business enterprises - 3 countries.

In the Member countries where there is governmental administration, Postal and Telecommunications Departments (Ministries) operate and own telecommunications. Eight countries offer telecommunications services combined with traditional postal services without separating accounts and balances. Seven countries have either separated these services from postal services or operate both as separate cost centres.

Interestingly enough, in an international comparison of telecommunications service-performance, the same eight countries with telecommunications and post services combined within one department, and with combined accounting systems, suffer from severe lags in the development of this vital service, a key to economic development in rural areas in the various Member countries from the viewpoint of the decentralization issue.*

The Tables 37 to 43 are an attempt to measure the degree of performance achieved in selected countries in terms of:

- Telephone density and structure of common carriers organisation (Tables 37 and 38).
- Charge for a local call in the capitals of selected countries (Table 39).
- Subscription rental per year in selected countries (Table 40).
- Development of "real telephone costs" from 1963-1970 (Tables 41 and 42).
- Productivity of telecommunications common carriers (Table 43).

Tables 37 to 43 invite criticism as to the sophistication of the figures. But in the absence of more detailed information, they must be considered as important indicators of the opportunities for various governments to assess the new information technologies to the advantage of their publics.

To determine the organisation and institutional arrangements that may be optimum for the balanced exploitation of the total computer telecommunications utility concept is not of course possible from looking at the countries with the highest and lowest numbers of telephone sets per 100 inhabitants and choosing the regulatory patterns accordingly. There are good reasons for believing that optimum institutional issues cannot be a choice between polarities, such as competition, monopoly and regulation, but rather a wise mixture allowing rational systems planning and economic incentives.

Due to limited information, it is possible only to suggest certain characteristics of the present organisational and institutional environment of telecommunication services, which inhibit the development of traditional as well as new services. Below follow some of the constraints which prevent the assessing of the technology, the setting up of a far-sighted economic policy (defined as a long-term strategy) and the translating of it into action.

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* R. Galley, French Minister of Post and Telecommunications in Introduction to: Eléments pour un schéma directeur des télécommunications, op. cit.

Table 37. TELEPHONE DENSITY AND ORGANISATION OF COMMON CARRIERS

	COUNTRY	TELEPHONES PER 100 INHABITANTS	TYPE OF OPERATION [1]	
			TELECOMMUNICATIONS SEPARATE	TELECOMMUNICATIONS AND POSTAL SERVICES TOGETHER
1.	United States	58	X	
2.	Sweden	56	X	
3.	Switzerland	48		X
4.	Canada	45	X	
5.	Iceland	35		X
6.	Denmark	34		X
7.	Luxembourg	33		X
8.	Australia	31		X
9.	Norway	29	X	
10.	United Kingdom ...	27		X
11.	Netherlands	26		X
12.	Finland	25		X
13.	Japan	25	X	
14.	Germany	22		X
15.	Belgium	21	X	
16.	Austria	19		X
17.	France	17		X
18.	Italy	17	X	
19.	Spain	14	X	
20.	Greece	12	X	
21.	Ireland	10		X
22.	Portugal	8	X	
23.	Turkey	2		X

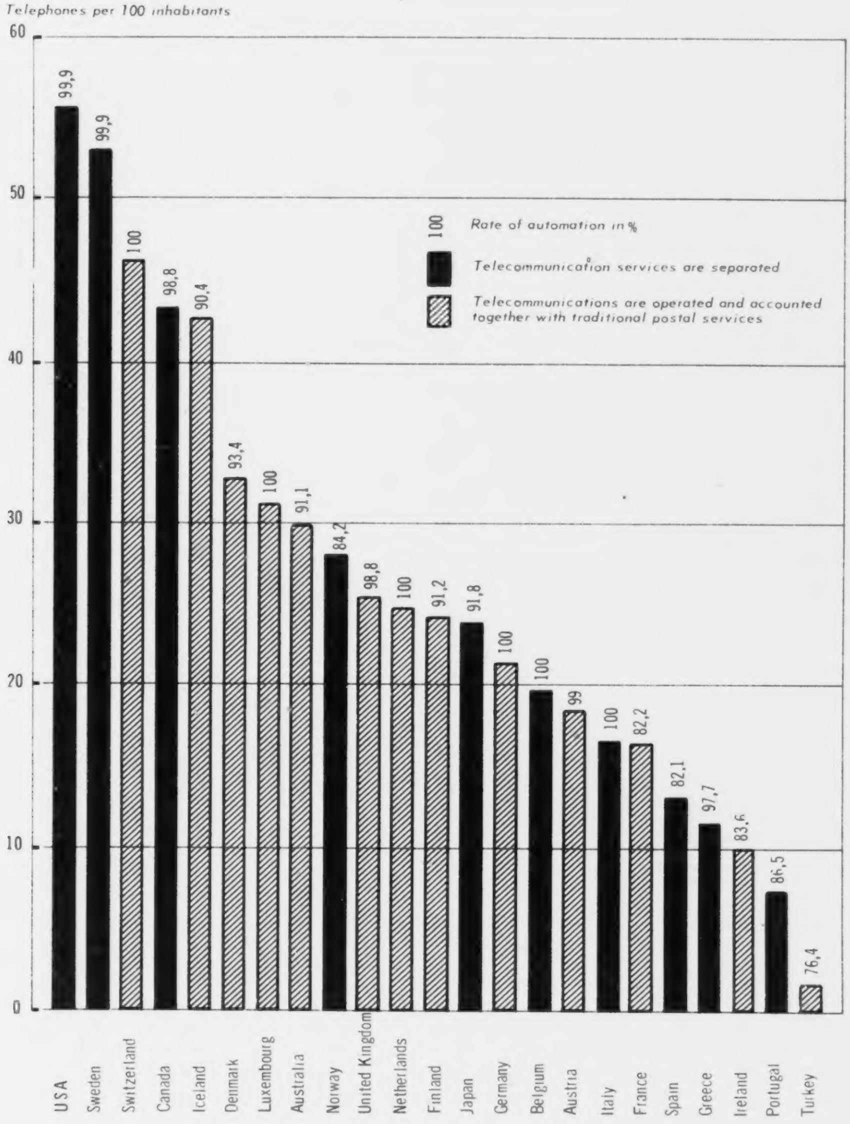
[1] Type of operation means whether the telecommunications service is provided by a separate corporation or combined in an organisation with traditional Postal Services.

SOURCE: The World's Telephones as of 1st January 1971, AT and T Long Lines, Overseas Administration.

Table 38

TELEPHONE DENSITY AND STRUCTURE OF COMMON CARRIERS ORGANISATION

(January 1, 1971)

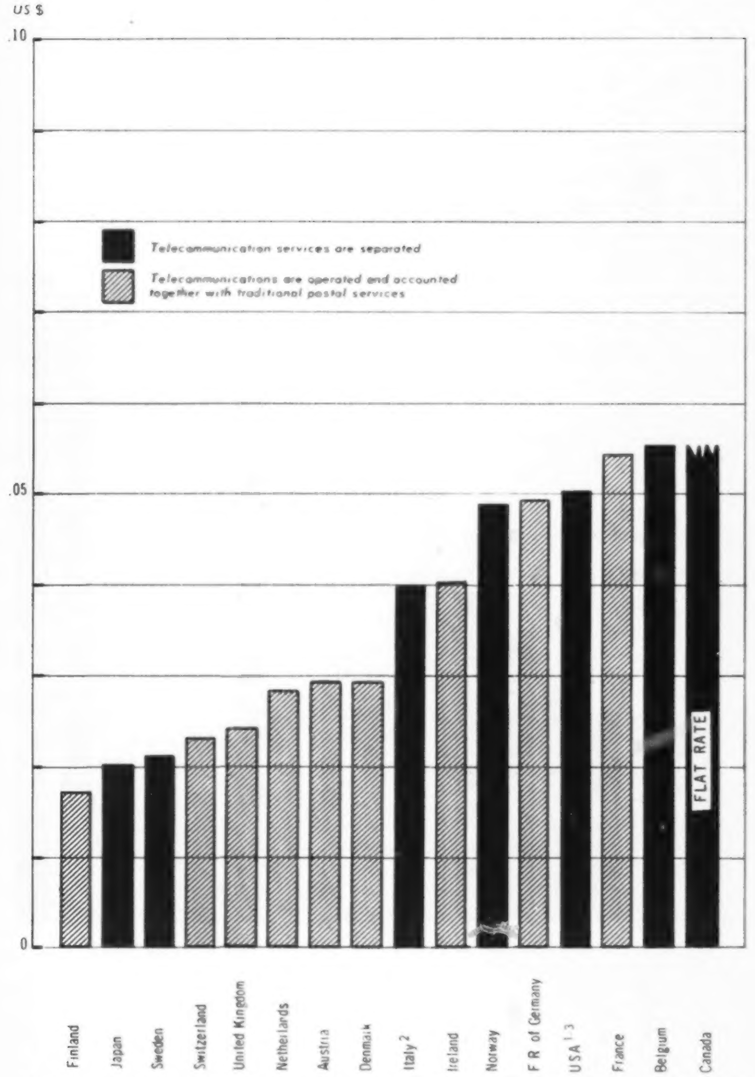


Source: The World's Telephones as of January 1, 1971, A T & T Long Lines, Overseas Administration, New York, February 1972.

Table 39

CHARGE FOR A LOCAL CALL IN THE CAPITALS OF THE DIFFERENT COUNTRIES[1]

(January 1, 1971)



1. It is worth while noting that in some countries private companies – not part of the PTT – Administration operate local telephone services in the countries concerned (i.e. Denmark, Finland).

2. Refers to October 1, 1972.

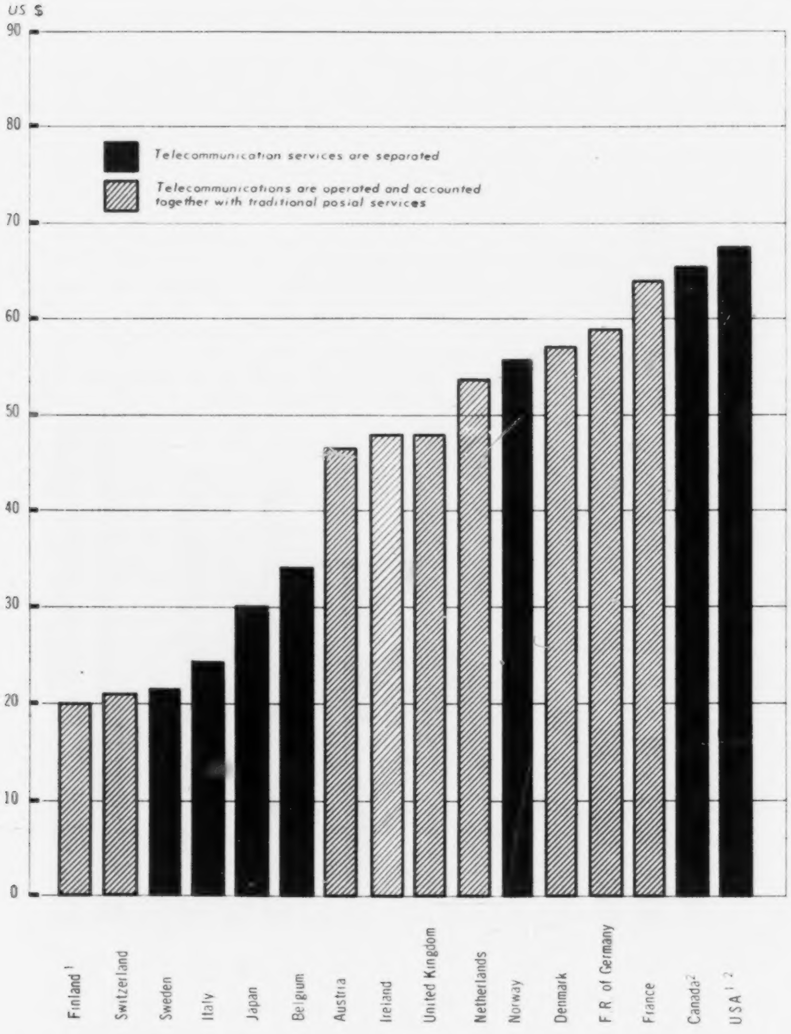
3 Charges for local calls in excess of 900 calls (New York City)

Source General Directorate of Swedish Telecommunications, April 4, 1972.

Table 40

SUBSCRIPTION RENTAL PER YEAR
(CAPITALS OF THE COUNTRIES)

(January 1, 1971)



[1] Finland : for shareholders only; for non-shareholders US $ 41,50.

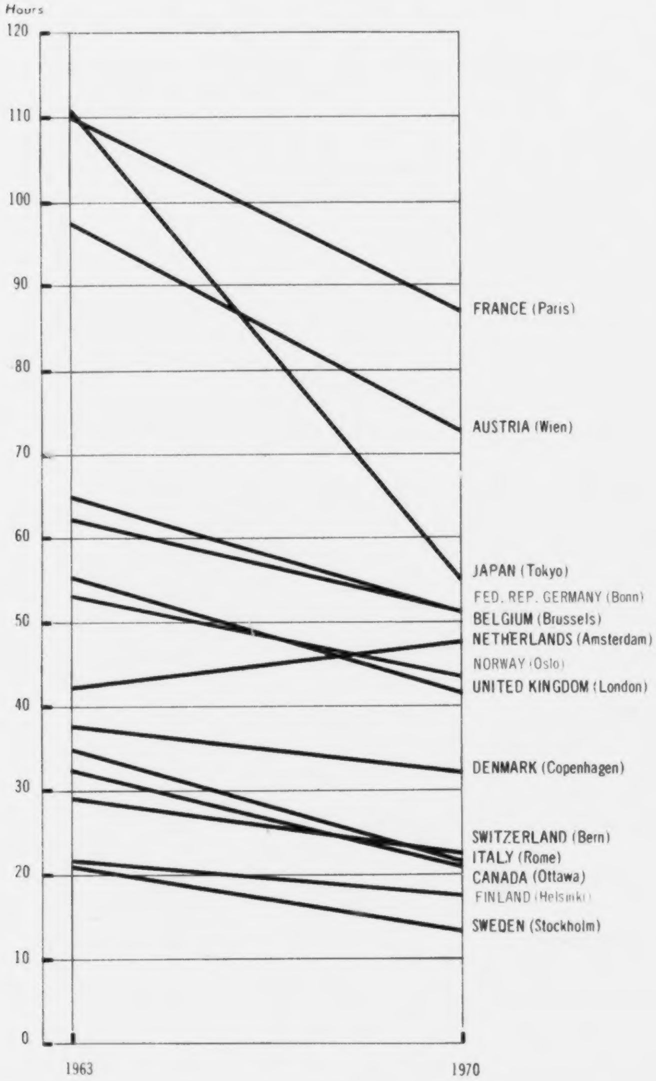
[2] Includes a flat rate for local calls.

Source : General Directorate of Swedish Telecommunications, April 4, 1972.

Table 41

DEVELOPMENT OF "REAL TELEPHONE COSTS"[1]

from 1963-1970



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[1] The time required for an average industrial worker in the Capitals of selected Countries to earn the amount of the fixed annual charge and 500 local calls during 1963 and 1970 (each end of year) in making the calculations, direct taxes have not been deducted from the wages

Source General Directorate of Swedish Telecommunications, April 4, 1972

Table 42. DEVELOPMENT OF "REAL TELEPHONE COSTS" FROM 1963 - 1970

COUNTRY	TIME REQUIRED (HOURS) (See footnote 1, Table 41)	
	1963 [1]	1970 [1]
Austria	97.0	72.0
Belgium	62.0	51.0
Canada	32.6	21.1
Denmark	37.6	32.2
Germany	64.7	51.1
Finland [2]	21.8	17.6
France	110.0	87.0
Italy	29.0	22.7
Japan	111.2	55.4
Netherlands	41.9	48.4
Norway [2]	52.9	43.7
Sweden	21.1	13.7
Switzerland	35.2	21.3
United Kingdom	55.5	41.6

1. Refers to the end of Calendar Year.
2. Refers to 1969.

SOURCE: General Directorate of Swedish Telecommunications, 4th April 1972.

Table 43. PRODUCTIVITY OF TELECOMMUNICATIONS COMMON CARRIERS

a) Number of Telephone sets per employee in the Telecommunications service[1]

Switzerland[2]	222
Italy	139
Netherlands	133
United States of America[3]	132
Sweden	107
Denmark	103
Belgium	98
Germany	94
Austria	89
France	81
United Kingdom[4]	58

b) Number of Calls per employee in the Telecommunications Service

Switzerland	166,000
Italy	157,000
Sweden	130,000
United States of America[3]	128,000
Denmark	117,000
Netherlands	108,000
Austria	98,000
Germany	69,000
Belgium	61,000
United Kingdom	40,000
France	37,000

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1. The number of employees has been determined by item 11.1 "Staff in Telecommunications Service", except item 11.2.1.2 "Telegraph" and 11.2.1.3 "Telegraph Distribution". The number of 5,934 employees in radio and television activities has been deducted from item 11.2.3 "Other personnel" for the Federal Republic of Germany. These figures are as of 31st December 1969.
2. For Switzerland it should be taken into account that the installation of all kinds of telephone and PBX-equipment is provided not only by the administration but also by private enterprises.
3. Refers only to AT and T.
4. Figures as of 1st April 1969.

SOURCE: "CEPT Statistical Proposal" 1970/71, AT and T Annual Report, 1971.

11.1.1 Annual budgeting period

In most European economies telecommunications fall under a Ministry and are thus subject to the annual budgeting procedure. As a consequence, Reinoud* has argued that:

- the investment resources granted are too small;
- the funds allocated generally cover only the fiscal year, and thus the national PTT does not know what funds will be available in the following years,

in addition, the various administrations are subject to the general macro-economy, "anti-business cycle" policy.

Consequently, although there is a large demand for telecommunications services which manifests itself in long waiting lists of potential subscribers, investment resources are often reduced in order to support the anti-business cycle economic policies of the governments.

These constraints, Reinoud asserts, explain the failure to satisfy the demand for telephone services, for example, and the difficulties in establishing long-term policy and planning in the telecommunications sector.

11.1.2 Innovation and depreciation patterns

There is another reason, closely related to this question, for reassessing the present organisational structure of the PTT. This is the linear depreciation patterns keyed to technical rather than economic life. Whereas planning horizons may be limited by the annual fiscal year, depreciation patterns may cover periods up to 20 years.** Consequently many new facilities already commercially available cannot be expected to be publicly available before 1990. This must be compared with the 4 - 5 year economic life-span of computer systems and satellites.

* Reinoud, Hendrik, General Director of the Netherlands PTT "Long-term Planning", Computer und Angestellte, Band II, 1971, p. 849 (translated here from the German text).

** Depreciation schedules generally applied by telecommunications common carriers are, for example:

Local switching centres:	15 years
Long haul switching centres:	10 years
Cables:	20 years

from Deutsche Bundespost, Annual Business Report, 1970, p. 116.

For the United States typical values are:

for local switching gear:	25-35 years
for toll service gear:	20-25 years.

Accelerated economic-life depreciation, which projects a larger share of equipment costs in a system's early years, seems to be preferable in such a period of rapid technological change, as we are experiencing. The clashing interests and mutual interdependence of demand for services, tariffs for services and introduction of new technologies that promise more versatility and substantial cost reductions, are, however, profoundly affected by the depreciation method used. Customers in the latter part of a system's usefull life (after a new technology has become available) should not have to bear amortization costs equal to those of earlier years; they should be allowed to take advantage of lower costs offered by the new technology.

Administrations obliged to provide postal and telecommunications services under a common cost-covering principle face the most crippling constraints.

This becomes evident when one compares the general revenue situation of the two different service categories. Postal services are highly labour-intensive (up to 80%) and pricing of these services is subject to political rather than economic reasoning. In conjunction with recent income developments and slow productivity increases, this has led to permanent deficits running into millions of accounting units. Telecommunications services, however, have become fairly lucrative activities.

In countries where the general cost-covering principle is applied, telecommunications services have had to subsidize the deficits of the postal services. In the case of multi-billion dollar companies this inevitably leads to enormous macro-economic disallocations of factor resources: the unproductive service branches absorb many productive resources. The supply of the highly lucrative services, in contrast, is effectively reduced by correspondingly high prices. This is done:

- to cover the deficits in the non-cost-covering postal services,
- to keep down the demand for services which are most in demand.

Thus it is no exaggeration to say that the amount of the deficit in postal services is an indication of the size of the financial resources available. In order to show that this policy, if continued, must lead to tremendous opportunity costs and thus operate against the mandate of serving the public interest, it must be recalled that the factor cost of labour in the long run can only increase, whereas capital costs seem to be decreasing.

In the past this horizontal transfer of revenue from the telecommunication service group to the postal service group, which is entirely distinct in its service character and structure as well as in its future importance, has severely affected the development of telecommunications in countries such as Germany, France and the United Kingdom. The important surplus revenues - differential profits, as they are called in economic theory - from telecommunications services have been used to cover deficits in the traditional postal services of the same administrations. In consequence, insufficient financial resources remained for capital investment plans in the rapidly expanding telecommunications sector.

Thus, these services have suffered from a permanent lack of capital which has had a negative influence on the investment policy and planning capacity of their administrations, all the more so as one of the economic functions of differential profits - providing investment resources to eliminate existing bottle-necks in the supply of services and goods - was not allowed to come into play.

In competitive markets it is an accepted fact that there will be price increases and differential profits if the demand for goods and services grows faster than supply. The relatively high profits then attract newcomers, and the entrepreneurs already operating do not hesitate to expand their production. There is no capital shortage, since foreign capital is eager to enter these expanding sectors, the more so as entrepreneurs and those offering investment capital can expect the highest rates of return the faster they expand supply. Under this market constellation, investment resources are first used to eliminate existing bottlenecks, because this guarantees the highest rate of return.

If the economic aspect only is considered, it is to be recommended that telecommunications administrations behave similarly.

11.2 SEPARATION OF POSTAL AND TELECOMMUNICATIONS SERVICES

To exploit the promising possibilities of new computer-telecommunications technologies and to channel these developments into the directions desired, the capital investment resource position of telecommunications authorities must be improved. In most Member countries this has been successfully achieved through diversification of postal and telecommunications services and total separation of their financial, technical and management resources.* This total separation is in the public interest: in satisfying, for example, the demand for telephones - and as an economic necessity in itself since new, cost-reducing technologies are concerned. It could reduce the economic and political constraints which at present hamper administrations by:

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* Layton, Christopher, European Advanced Technology, p. 192.

- improving the capital investment position of the administration and providing a key for service planning and pricing policy,
- diminishing the influence of pressure groups, and
- improving the motivation of the manpower employed.

11.2.1 Factors favouring separation

Capital funding

As the surplus revenues from telecommunications services would no longer be used to cover deficits in postal services but would remain in the telecommunications sector, the investment resources situation of the administrations would improve considerably. Thus, the planning and policy capacity for new services would be able to keep up with the rapidly growing demand. Moreover, investment policy also contains the key to pricing policies for telecommunications services.

With reference to related economic issues, the British Government in 1969 gave authorities exploiting the post and telecommunication services the status of a public corporation (with legal safeguards to prevent dilution of resources) in order to facilitate appropriate economic behaviour.

Similarly, the responsible Dutch Minister* is examining the possibility of giving the PTT an organisationally separate status, probably similar to a stock-corporation. Again, the reason is to improve its policy and planning capacity.

The stock-corporation concept, with many shareholders, is gaining momentum as it opens up possibilities for the release of government resources. Since telecommunications services are highly capital-intensive and promise high rates of return per dollar invested, they seem to be well suited to the global income redistribution policy involved in wide-spread shareholding.

A new pricing policy

The theoretical discussions about economic criteria for establishing the fee (tariff) policy for telecommunication services seem to be settled now. The formerly postulated strict cost-covering fee principle has lost ground to the market price concept, which identifies the real degree of scarcity of a service, including the reasonable rate of return on investment. *

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* Reinoud, Hendrik, op.cit., p. 854.

Monopoly or above-average profits are an important consideration. This problem will find its own solution provided that efforts are undertaken to expand correspondingly the supply of telecommunication services, since this will lead to a competing away of these profits.

It is the underlying technique-based cost-philosophy inherited from the network designed for voice-transmission which has come under fire most recently with regard to new services, such as telecommunications-based computer systems. The cost factors in the analogue plant are time, duration of call and distance. With the new trend towards digital transmission where millions of bit streams travel along channels, users would like to see time and distance cost criteria replaced by a volume factor, for example. Additionally it is argued that, as the allocation of joint costs for various telecommunications services is an ill-defined job, at best arbitrary, at worst discretionary,** the introduction of a flat rate is the proper solution. *** This has been supported by various Canadian experts who conclude that some 85% of all communication costs are overhead costs.

Since telecommunications service fees will play a strategic role in the widespread use of the new systems, this approach merits thorough investigation, the more so as it promises tremendous cost savings especially when present metering techniques become obsolete.

Relief from pressure groups

With the total separation of postal and telecommunications resources another delicate constraint could become obsolete: the influence of pressure groups unrelated to telecommunications. Thus, publishing house and mail order representatives on the Boards of Directors of telecommunications administrations, who have successfully maintained a low pricing policy for the very services that cause the postal deficits, could be excluded from policy issues concerning telecommunications services. It should be kept in mind that the growing deficits in the case of printed matter and cash-on-delivery (payment on delivery) services brought on the increase in telephone rates in Germany (July 1971) and the tariff increases announced for 1972 in France* and the United Kingdom.** Further increases have been announced for Germany in 1972.***

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* The British Post Office now considers a 10% rate of return on investment as reasonable for telecommunications. A similar rate of return is included in the price-funding of the Swedish Central Telecommunications Headquarters.

** Irwin, Manley R., A Multiple Access Computer Network: The Role of the Common Carrier, 1971, p. 5.

*** Telecommission, p. 86.

With respect to the relationship between users and the management boards of telecommunications services, the British solution deserves special mention since it has institutionalised the representation of users' interests in the form of the Post Office Users' National Council. This seems a significant step forward for other Member countries to consider.

Improved attitudes

The separation of postal and telecommunication resources might also have a very favourable psychological effect: it could relieve some of the frustration experienced in the past by responsible telecommunications managers who witness surplus operational revenues employed for postal deficits. Change in this obsolete policy might mean a drastic change in their attitudes, not least of all in assessing new telecommunications technologies.

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* Le Monde, 28th October 1971.

** The Daily Telegraph, 22nd October 1971.

*** Frankfurter Allgemeine Zeitung, 13th November 1971.

Chapter 12

A NATIONAL PROGRAMME

12.1 NATIONAL INTEREST

The intention in the preceding chapters was to emphasize the multi-faceted nature of the growing interdependence of computers and telecommunications technologies and its importance to most Member countries. The potential of these technologies, the "pay-off" from their proper exploitation, is expected to be greater than the pay-off from the peaceful uses of atomic energy, the moonshot or the Anglo-French Concorde.*

The giant strides made in the technology of the various computer-hardware components and the impending revolution in telecommunication technologies indicate that the trend towards the "total computer telecommunication" utility concept is clear and unmistakable.**

In order to prevent politics, lobbying, monopolistic sloth or destructive competition from diminishing the riches that the new technology can produce, many experts are calling for a detailed policy designed:***

- to facilitate the introduction and control the shape of the new infrastructure;
- to reassess existing telecommunications services and the structure of the computer-telecommunications common carriers industry;
- to guide this key-industry to future qualitative and quantitative economic growth.

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* Martin, James, Future Developments, p. 379.

** Dunlop, Robert A., The Emerging Technology of Information Utilities, p. 45.

*** Parker, Edwin B., op. cit., p. 51.

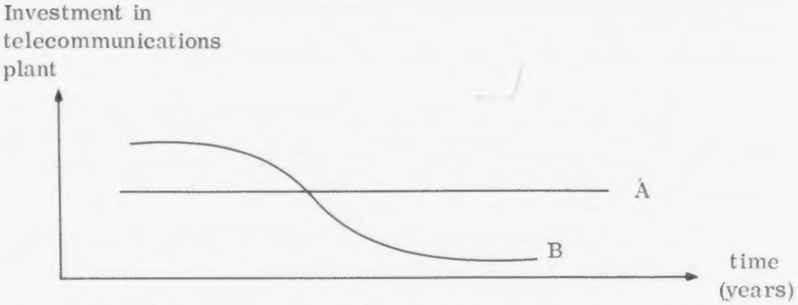
If the promises are to be translated into action and the most serious obstacles to progress avoided, something more imaginative is required than laissez-faire and "shareholders' interests", or the PTT concept of leaving basic decisions to "the (often political) consideration" of an administration.

It seems likely that the future telecommunication network will be fully digital. The transmission cost will be a fraction of today's total costs and the network will be much more versatile. This has led to the technical-integrated concept of a network carrying voice, video, facsimile and data signals over the wide physical spectrum of paired wires, cables, wave guides and satellites.

The problem of progression from today's analogue plant to tomorrow's digital plant is not a technical but rather an economic and political one, and Martin emphasizes the danger that, all other things being equal, with the present organisational structure of the telecommunications industry as it is, much of the riches that these technologies could bring will not be harvested. *

To take Course B (Table 44) rather than Course A would result in a lower cost in the years ahead, even if at the expense of higher costs in the immediate future.

Table 44. "ECONOMIES" OF THE SYSTEMS-APPROACH



SOURCE: Martin, James, Future Developments in Telecommunications, p. 379.

If alternative B represents the building of a digital network with integrated telephone, data, facsimile and other facilities, it will provide much greater capacity in the future than alternative A.

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* Martin, James, op. cit., p. 379.

Some of the economic gains have already been discussed. The question now is whether the institutional framework within which the choice of alternative paths will be made is optimal. Martin states that the "future value to the economy" argument in the assessment of computer-telecommunications technologies, filled as it is - in the absence of a blueprint - with so many intangibles, would rarely persuade business firms to invest the necessary funds. Consequently, if it is left to investment bankers to select the course, it will not be alternative B.* Therefore, to leave the optimum assessment to existing carriers and administrations within the present environment is dangerous because monopolies tend to have built-in, stifling attitudes toward innovation. Thus they may suffer lack of imagination and courage to invest sufficiently in this new and vital future resource.

The creation of national systems of the scale and the potential described in this report appears economically and politically impossible without a concerted approach on the broadest possible base. This approach should include the following segments:

- computer manufacturers (incorporating the wide spectrum of terminals and related component manufacturers);
- computer service bureaux;
- common carriers and broadcasters;
- software houses;
- present and potential users.

Consequently Canada is looking toward a "major programme approach"** which, like any other national undertaking, such as the Apollo project, is trying to identify major objectives of social and economic needs likely to be fulfilled by computer/telecommunications technology, and to fix them into national science and technology policy as well as economic policy. Some of the objectives, as indicated earlier, might be:

- computer-aided instruction;
- a "paperless" tertiary (services) sector;
- innovation within critical public areas which are causing tremendous deficits and thus absorbing urgently needed public financial resources (e.g. postal services, transportation, etc.).

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* Martin, James, op. cit., p. 379.

** Telecommission, 5(a), p. 82.

12.2 INSTITUTIONAL ASPECTS

After identifying some of the social and economic needs and aims, the crucial question concerning the proper institutionalisation of such national efforts in the field of computer telecommunications systems comes to the fore.

In the United States it is the Federal Communications Commission which is trying to stimulate the growth of diverse services and increase flexibility and efficiency in telecommunications. In most Member countries the political responsibility and/or operation of telecommunications is exclusively provided by government executive departments or public corporations. The constraints, some of which were discussed in the preceding chapters, centre around their relatively static behavior, first, in the relationship between the regulatory institutions and the firms that constitute the communications industry, and second, with respect to user needs.

In the case of the FCC in the United States it should be remembered that this regulatory body was founded in 1934 and thus had to face the structure and conduct of the telecommunications industry as a fait accompli. Hence, in the past, its attempts to control a monopolistic market structure were - because of limited staff, finances, research resources, and political support* - restricted to the control of tariffs rather than establishing policies to foster introduction of new, cost-reducing technologies into the telecommunication network or the provision of new services. The same is largely true in most Member countries, although they do not have a similar regulatory controlling agency, but provide and operate this service principally through a special department.

However, our discussion should not be considered as aimed at abolishing the existing institutional "environment", but at achieving a more creative and affirmative role for present or future regulatory agencies whose work it is to anticipate developments. Where new applications and services are concerned we have argued that a lesson should be learned from experience and the market should be prevented from bringing about the proliferation of computerized telecommunications-based credit card systems for banks, for example, long before such systems are available in the fields of medical, educational or consumer information, where public need is less coincident with or adequately represented by private commercial interests.

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* Kiestenbaum, Lionel, The Regulatory Context of Information Utilities, p. 94.

To overcome these shortcomings Kiestenbaum* recommends, within regulatory contexts, a mixture of technical and economic expertise, private and government initiative, monopoly and regulation, flexibility and far-sighted planning and rule-making to guarantee a balanced national assessment of challenging computer/telecommunications technologies.

12.3 PLANNED INNOVATION

Earlier in this report the term "national integrated computer/ telecommunications agency" was used to describe a possible federal government institution that could co-ordinate the activities and incentives involved in assuring the national development of an integrated computer/ telecommunications network in the public interest.

Compared with the present situation (that is, the structure and status of industries now involved in telecommunications), the new institutional "environment" would be characterized by the strict separation of planning and policy-making from operational functioning of telecommunications and computing services.

Physically, the network would integrate various sub-networks, such as telephone, telex, facsimile data, video, cabled TV, and radio broadcasting. Thus it might in technical terms accomplish perfect "systems integrity". (See Table 45).

Unlike the present situation, planned co-ordination might allow as much competition as possible and as much regulation as necessary, since it would be operated according to stated criteria, which would be principally operational needs and economic advantages.

There are many different forms and a variety of alternatives for such an agency, and it would be an excellent task for OECD to explore some of them as well as the fields in which the agency could engage.

However, in spite of its precise nature, it is important to note that this would be a co-ordinating and catalytic agent, a regulatory body or even the principal source of funding, rather than an operator of systems.

The separation of "operating" from "policy-making" responsibilities might also be an attractive concept from other points of view for many countries.

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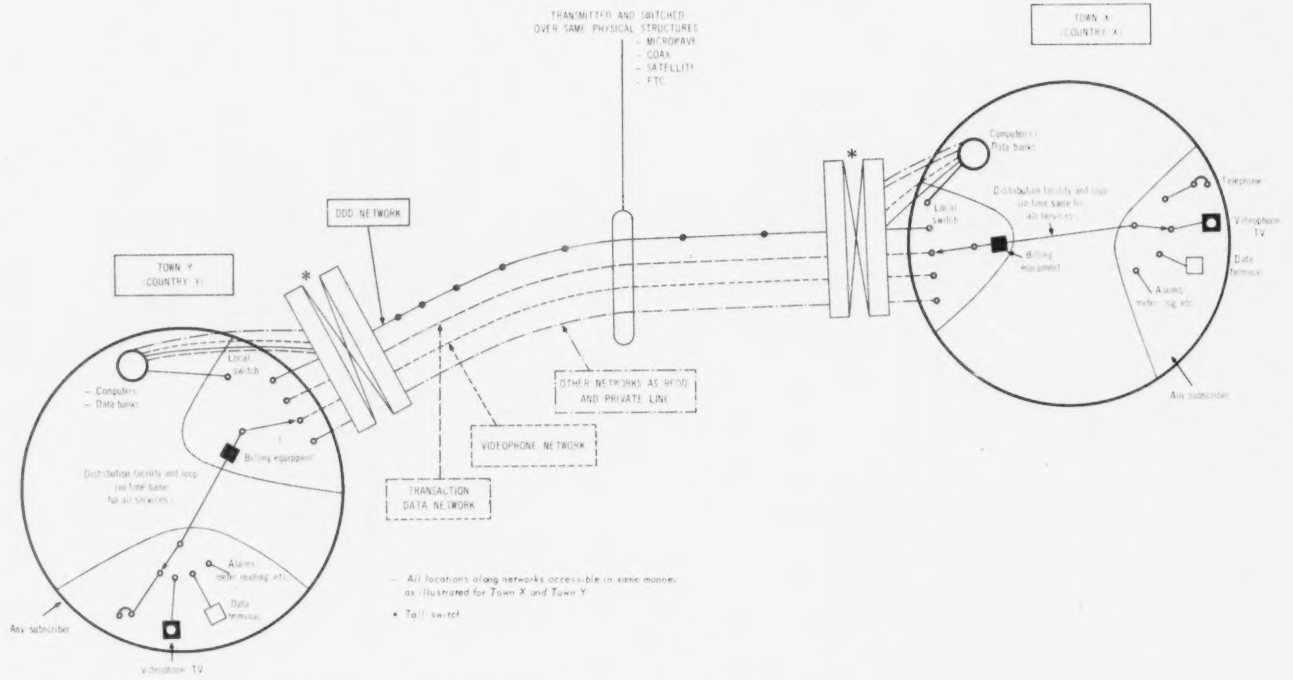
* Kiestenbaum, Lionel, op. cit., p. 97.

Table 45

A VERY SIMPLIFIED VIEW OF THE POTENTIAL CAPABILITIES OF THE FUNCTIONALLY SEPARATE BUT PHYSICALLY INTEGRATED TELECOMMUNICATION FACILITIES



Source : Trans-Canada Telephone System in Communications, Computers and Canada, Ottawa, 1971

Since the governmental agency would set goals - desired applications, foreign attachment issues, standards, etc. - by means of flexible policies open to new trends, it might be possible for the first time to deal with new growth industries in times of rapid change. Although there can be no policy that gives absolute assurance to an industry characterized by rapid change, there seems to be a chance of achieving economic compromise between retarding an innovative and developing industry and blind governmental whimsy in the field of computers and telecommunications.

Additionally, since the agency could set goals within a regulatory framework and leave the operation of telecommunications services to private industry (for example), many of the actual capital shortcomings could be solved, because shareholders could supply the funds for these highly lucrative services.

12.4 FUNCTIONS OF THE AGENCY

The possible, if not probable, central functions of such an agency would be:

- establishing communication policy;
- assuming the planning function;
- organising research and development;
- assuring standardization;
- licensing attachments;
- underwriting financial support, etc.

However, it is beyond the scope of this introductory report on the complex field of computers and telecommunications to elaborate these points. It would be necessary to go into delicate questions of controlling market entry, mergers, levels of profits and rates, supervision of carrier practices and conditions of service. (Such controls are deemed warranted when competition is not feasible, for example, when large-scale economic requirements result in a "natural monopoly" situation.)

This highlights once again the regulatory controversy over whether common carriers should be allowed to enter into information utilities, and how: as distributors of raw computer power or as distributors of such information services as visual consumer information?

A very early policy measure for the agency would be to guide the proliferation of appropriate telecommunication services for remote data-processing users. Consequently it would first have to accelerate the innovative process in existing common carriers so that they could meet remote data-processing requirements. Second, it would have to guarantee that economies of scale and productivity increases brought about through new telecommunication technologies would be passed on to users in the form of lower tariffs.

To do so, it must no longer be beyond the scope of any regulatory policy to examine thoroughly the relationship between common carriers and equipment supplier(s). Thus an agency of this type would have to go into such questions as the degree of economic advantage to be gained by horizontal or vertical diversification of this relationship.

With respect to the predictable success of such a telecommunication policy, little information is available. Some recent experiences in the United States however are encouraging, and emphasize the necessity for a telecommunications policy concept:

- American common carriers have been required to give way to the demands of the new information services on foreign attachment, interconnections, line-sharing, specialized data carriers and other issues in the absence of decisions and simply as a consequence of signal-setting when the FCC commissioned its computer/telecommunication enquiry.
- The FCC's "above 890 decision"* would be interpreted as another step away from absolute market protection for established common carriers. Since this decision could have led to potential competition from private microwave carriers, AT and T altered its private-line rate structure drastically. The company introduced its Telpak classification of private line service, with tariff reductions ranging from 51% to 85%.**

In addition, Kiestenbaum*** reports that up to the present there have been no significant losses in the integrity and viability of communication common carriage, but rather substantial gains in flexibility and diversity and a more receptive environment for new developments.

Thus there are solid reasons for asserting that a communication policy-and-planning agency, from the moment of birth of a new technology, can allow competition in the planning stage of new services and tariffs. Consequently, the present "national monopoly" philosophy in the field of telecommunications (now a matter of dogma and presumption) could be disproved on the pragmatic grounds of technical and economic experience.

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* Allocation of frequencies in bands above 890 MHz.

** Melody, William, Market Structure and Public Policy in Communications, 28th December 1969.

*** Kiestenbaum, Lionel, op. cit., p. 89.

To fulfil such a long-range policy of creatively shaping telecommunications and computer systems on the basis of well-thought-out solutions to future as well as immediate problems, the agency would have wide-ranging responsibilities, including:

- analysing and forecasting national needs for computer/telecommunications services;
- assessing computer/telecommunications technology as well as electronic-video-recording (EVR) techniques;
- assessing the probable social and economic impact of new developments;
- designing the configuration and outlay for computer/telecommunications networks;
- developing the necessary economic, regulatory and legal framework for networks;
- providing focal points for the expression of diverse views and interests, and setting adequate standards for both computers and telecommunications.

12.5 CONSIDERATIONS OF ECONOMIC GROWTH

With respect to the urgency of such a "major national approach" and the enormous investment resources it is likely to require, it should be noted that a project of this magnitude could have a multiplier effect on the entire economy.

The productivity increases which a telecommunications-based system could offer as a working tool in the tertiary sector and in other crucial national services, such as health, education, urban development, transportation, air pollution control, and consumer information systems (countering inflation), promise to be enormous; their quantification could be the subject of a further report.

Major productivity increases could also be expected; if these systems were applied to government administration alone, savings would be in the order of 10% of the annual government budget (as was remarked at the beginning of this report).

These economies, together with the multiplier effect of the investment programme to install these systems, would lead to substantial increases in the gross national product, the primary source for further improvement of the quality of life and material well-being of people in Member countries. This is even more important because present key industries may well lose their leadership through market saturation and anti-pollution trends.

Consequently, investments which appear very large in 1971 may seem relatively trivial in 1980. In the past, government funding has always been necessary for developing "big science"; this has also been true of high-cost technologies, such as aircraft, CPU technology, etc. It has been true, too, for automobiles, if one considers the cost of highways; a car without roads would be like a videophone without communication lines.

Indeed in most OECD countries* there are major government road-investment plans up to the year 1985, although many experts agree that cars may have passed their zenith as a growth industry. Consequently, long-range planning in the future key industry of telecommunications might well be a preparation for re-deploying resources from an industry with declining growth trends and thus preparing the way to stability and continued economic growth.

12.6 HORIZONTAL POLICY APPROACH

To cope with the high stakes at issue, however, the perspectives of planning must necessarily be horizontal; the totality of telecommunication and computer resources must be regarded as a basic ingredient in every nation's wealth and the principal determinant of future national development.

With telecommunications becoming the dominant technical and economic factor of the computer/telecommunications complex the leverage effect of a farsighted communications policy for the development of all industries concerned should be exploited.

This has been explicitly recognized in some OECD countries: in Canada, for example, the Department of Telecommunications has

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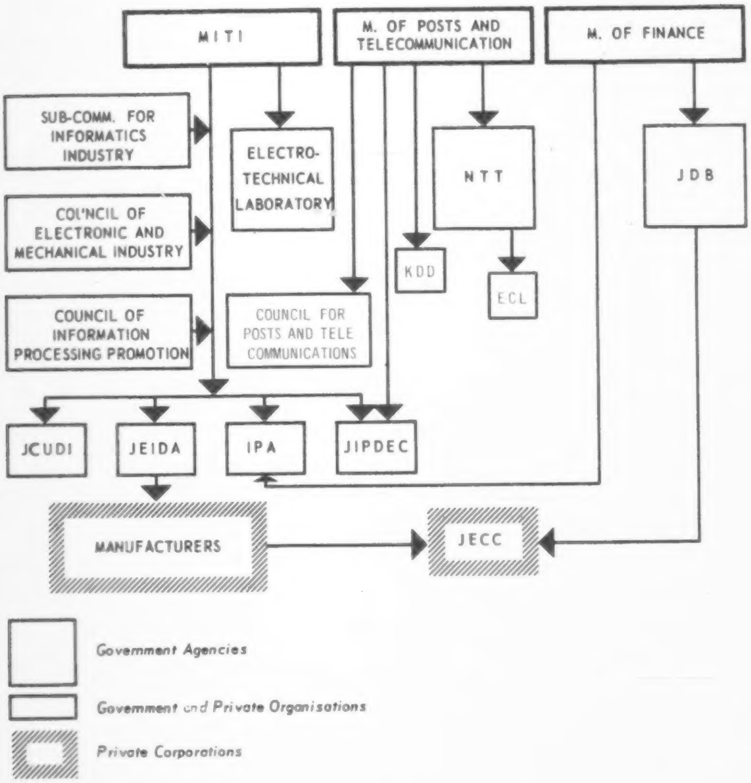
* For example,	United Kingdom	£	100 billion
	United States	$	180 billion
	Germany	DM.	150 billion

(Information from OECD Road Research Group.)

Table 46

INSTITUTIONAL STRUCTURE OF INDUSTRIAL INFORMATICS PROMOTION PROGRAMME IN JAPAN


MITI
M. OF POSTS AND TELECOMMUNICATION
M. OF FINANCE
SUB-COMM. FOR INFORMATICS INDUSTRY
COUNCIL OF ELECTRONIC AND MECHANICAL INDUSTRY
COUNCIL OF INFORMATION PROCESSING PROMOTION
ELECTRO-TECHNICAL LABORATORY
COUNCIL FOR POSTS AND TELE COMMUNICATIONS
KDD
NTT
ECL
JDB
JCUDI
JEIDA
IPA
JIPDEC
MANUFACTURERS
JECC
Government Agencies
Government and Private Organisations
Private Corporations

LEGEND :

MITI : Ministry of International Trade and Industry

NTT : Nippon Telegraph and Telephone Corporation

ECL : Electronic Communication Laboratory

KDD : Kokusai Denshin Denwa Co.

JDB : Japan Development Bank, (a new department will be created to finance and support software and consultancy industry)

JEIDA : Japan Electronics Industry Development Association (Standardisation is achieved together with MITI)

JCUDI : Japan Computer Utilisation Development Institute (Association of large EDP users)

JIPDEC : Japan Information Processing Development Centre

JECC : Japan Electronic Computer Company (leased equipment promotion).

IPA : Information Technology Promotion Agency

Source : Japanese Delegation to OECD, June 6, 1972 commissioned a computer/telecommunications task force to evaluate concrete plans for a major national programme. In Germany the second EDP promotion programme merits consideration, although it was drawn up without reference to the leverage effect of an overall telecommunications policy. As for Japan, Table 46 indicates the national effort to promote the new technologies by embedding the industries concerned in an all-encompassing national science-technology and industrial policy.

Chapter 13

INTERNATIONAL CO-OPERATION

It has been argued that, in order to exploit some of the promises of telecommunication-based computer systems, the response of existing national institutions should not be limited to narrow technical considerations, but should be geared to deal with change. Thus it was concluded that governments would have to develop a proper communications policy with appropriate institutions.

Assessment of these technologies, which are by nature international, cannot be limited to one country and clearly requires close international co-operation. (If some countries establish a telecommunications policy whereas others do not, the international level of sophistication of future telecommunications services will finally be determined by the lowest common denominator.)

With traditional telecommunications services such as telephony, telex and radio, etc., this co-ordination function is provided by the International Telecommunication Union (ITU)* and its permanent organs:

- the International Frequency Registration Board (IFRB);
- the Consultative Committee on International Radio (CCIR);
- the International Telegraph and Telephone Consultative Committee (CCITT).

According to their mandates these organisations of governments (ITU) and administrations (CEPT) are mainly concerned with a posteriori technical and operational aspects "on the border" (interconnection recommendations) of traditional telecommunications.

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* The ITU was founded in 1865 and became the specialized agency of the United Nations for telecommunications in 1947.

It must, however, be mentioned that CEPT studies questions regarding new services and facilities in the telecommunications and data communication fields. CEPT is also involved in a long-term planning activity for new techniques and services.

An interesting initiative has been taken by 16 European PTT administrations who together have organized a large market study in the data-communications field covering the period 1972-85. *

None of these organisations, however, has the mandate to foster the introduction of available technologies** in terms of when and how they are to be applied, for which services and at what prices, etc. Moreover, doubts have recently been expressed*** as to whether the formulation of technical standards and future technical data-transmission requirements by the above-mentioned agencies has been sufficient.

This is all the more important since the main issues affecting international proliferation of telecommunication-based technologies are of a political nature. This is amply illustrated by the PAL and SECAM colour TV controversy. It is also necessary to take into account the different levels of economic and technological capabilities for producing the lowest cost facilities in this and related fields.

Consequently, if the international telecommunications industry is to enjoy the predictability of telecommunications policies at a national level, some means must be developed for isolating such basic economic conflicts and for coming to some understanding well in advance of the time when specific new facilities are installed.

* The Eurodata market study covers:
- traffic distribution;
- customer needs;
- data-processing system development;
- remote computing technical analysis;
- overall European data-communication needs.

The study is being done for the following countries: Belgium, Denmark, Finland, Iceland, Ireland, Netherlands, Norway, Luxembourg, Portugal, West Germany, United Kingdom, Spain, Sweden and Switzerland. Italy has accepted the same research principles, but has commissioned another consultant company. France, though not a participant in the study, is contributing the necessary information base.

** Such as the Boeing 747's digital network system for passenger entertainment, control of passengers' seat lights and the usual announcement and stewardess call systems. The major reason for using a multiplex system was the weight-saving made possible (about 1,000 pounds) by replacing the many paired-wires with a single coaxial cable about 15 mn. in diameter.

*** Cf., Whitehead, Clay T., Director, Office of Telecommunications Policy, "Remarks at a Conference on Electronics", p. 14.

It is most likely that such a policy would considerably improve the innovation process in telecommunications and strengthen international competitive market forces. Ideally, besides stimulating further improvements in the innovative process, this would lead to the harmonization of world and national market prices for most components of the information utility. At present the difference between world and national market prices is sometimes as great as 100%. For example, average plant investment for a telephone line costs about \$ 500 in the United States, * whereas for most European countries \$ 1,000 is the standard. **

Ministers of Science and Technology have agreed that OECD provides a convenient and flexible framework for promoting international co-operation in this direction. *** Thus a major OECD concern - recognized as vital to every Member country - could well be the achievement of early agreement on economic and political policies in the field of digital telecommunications, computers and related components in the planning stage.

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* President's Task Force on Communications Policy, Staff Paper 1, Part 2, June 1969, p. 19.

** FITCE Report, p. 32.

*** Ministers of Science of OECD, Paris, 14th October 1971, Communiqué, p. 5.

GLOSSARY

For the sake of consistency, most of the technical terms used in this report are taken from other recognized glossaries such as:

- List of Definitions of Essential Telecommunication Terms, International Telecommunication Union, Geneva.
- Data Communications Glossary, International Business Machines Corporation, Poughkeepsie, New York.
- Telecommission Study, Department of Communications, Ottawa, 1971.
- International Federation For Information Processing and International Computation Centre.
- IFIP-ICC Vocabulary of Information Processing North-Holland Publishing Company, Amsterdam, 1966.

Access time

Time required in a computer to move an instruction or a piece of data from a memory unit into the central processing unit.

Address

A coded representation of the destination of data, or of their originating terminal. Multiple terminals on one communication line, for example, must have unique addresses. Telegraph messages reaching a switching center carry an address before their text to indicate the destination of the message.

1. A label, usually a number identifying a location where information is stored.
2. The destination of a message.

Analog data

Data in the form of continuously variable physical quantities. (Compare with Digital data.)

Analog transmission

Transmission of a continuously variable signal as opposed to a discretely variable signal. Physical quantities such as temperature are continuously variable and so are described as "analog". Data characters, on the other hand, are coded in discrete separate pulses or signal levels, and are referred to as "digital". The normal way of transmitting a telephone, or voice, signal has been analog; but now digital encoding (using PCM) is coming into use over trunks.

Alphanumeric

An expression derived from the words alphabetic and numeric which means "including both numbers and letters".

Application Services

A general term for the various tasks that a Computer Utility might perform, for example, payroll processing, information retrieval, invoicing, process control, etc.

Application Software

The special programs which serve to organize the raw computer power provided by a computer so that it is able to perform application services.

ARPA

(1) An acronym standing for the Advanced Research Projects Agency of the US Department of Defense.

(2) An acronym of an experimental broadband-data-Network of the above-mentioned Agency.

ASCII

(American Standard Code for Information Interchange.) Usually pronounced "ask-ee". An eight-level code for data transfer adopted by the American Standards Association to achieve compatibility between data devices.

Associative Memory

A memory in which the cells can be directly address by content.

Automatic calling unit (ACU)

A dialing device supplied by the communications common carrier, which permits a business machine to automatically dial calls over the communication networks.

Automatic dialing unit (ADU)

A device capable of automatically generating dialing digits. (Compare with Automatic calling unit.)

Auxiliary Storage

See External Storage.

Binary

Pertaining to a system with only two possible states, i.e. ON or OFF, often designated by 0 and 1.

Binary Code

A code in which the entities can assume only two possible states.

BIT (Binary digit)

One of the two digits in the representation of data in a binary system, i.e., 0 and 1.

Bit Rate

The speed at which bits are transmitted, usually expressed in bits per second.

Bandwidth

The range of frequencies available for signaling. The difference expressed in cycles per second (hertz) between the highest and lowest frequencies of a band.

Baseband signaling

Transmission of a signal at its original frequencies, i.e., a signal not changed by modulation.

Baud

Unit of signaling. The speed in bauds is the number of discrete conditions or signal events per second. (This is applied only to the actual signals on a communication line.) If each signal event represents only one bit condition, baud is the same as bits per second. When each signal event represents other than one bit (e.g., see Bit Rate), baud does not equal bits per second.

Baudot code

A code for the transmission of data in which five equal-length bits represent one character. This code is used in most DC teletypewriter machines where 1 start element and 1.42 stop elements are added.

Broadband

Communication channel having a bandwidth greater than a voice-grade channel, and therefore capable of higher-speed data transmission.

Cathode Ray Tube

A vacuum tube in which a controlled electron beam strikes a screen for the purpose of creating a visual display, storing information, or reading out information.

Cathode Ray Tube Memory

A storage device in which information is stored in the form of a pattern of electric charges on the face of a cathode ray tube.

Central processing unit

That portion of a digital computer system where instructions are interpreted and executed, separate from the main storage unit.

Channel

A path for electrical transmission between two or more points. Also called a circuit, facility, line, link, or path.

Channel, analog

A channel on which the information transmitted can take any value between the limits defined by the channel. Most voice channels are analog channels.

Channel, voice-grade

A channel suitable for transmission of speech, digital or analog data, or facsimile, generally with a frequency range of about 300 to 3,400 cycles per second.

12-channel group (of carrier current system)

The assembly of 12 telephone channels, in a carrier system, occupying adjacent bands in the spectrum, for the purpose of simultaneous modulation or demodulation.

Character

The actual or coded representation of a digit, letter, or special symbol.

Circuit

A means of both-way communication between two points, comprising associated "go" and "return" channels.

Circuit, four-wire

A communication path in which four wires (two for each direction of transmission) are presented to the station equipment.

Circuit, two-wire

A metallic circuit formed by two conductors insulated from each other. It is possible to use the two conductors as either a one-way transmission path, a half-duplex path, or a duplex path.

Carrier

A person, usually a company or corporation who for hire conveys between the points of origin and reception, intelligence communicated by wire, radio, optical or other electromagnetic systems.

Carrier is also used to describe a signal which is used to carry intelligence by being suitably modulated, or impressed, by it. Carrier communication is also used to describe the technique of transmitting one or more messages over a single open-wire pair, cable pair or radio circuit.

CATV (Systems)

The term "Community Antenna Television (CATV or Cable Television) System" means any communications facility which makes use of wire, cable or other transmission line installation to distribute, to subscribing members of the public, signals which it receives either directly or indirectly over the air from television broadcasting stations. The system may also carry signals which originate in studios other than those associated with TV broadcasting stations, or which are received from FM or AM sound broadcasting stations.

Central office

The place where communications common carriers terminate customer lines and locate the switching equipment which interconnects those lines. (Also referred to as an exchange, end office and local central office.)

Coaxial cable

A transmission line in which one conductor is centered inside of a metallic tube that serves as the second conductor. Commonly used for the transmission of radio frequency signals over relatively short distances. Also used as the transmission means for undersea or overland multichannel communications systems.

Communications common carrier

A company which dedicates its facilities to a public offering of universal communications services and which is subject to public utility regulation (AT and T, PTT).

Computer

A device which can store and process and make available information which has been entered in either digital or analog form, e.g. digital computer, analog computer.

Console

The control panel of a computer where the machine's actions may be observed and controlled. A remote console can be located at a site separate from the central computer.

Conversational Mode

A method for communicating between a human operator at a terminal device and a computer which permits queries and responses to alternate between human and computer to create what amounts to a man/machine dialogue.

Core

See Magnetic Core.

Cross-Subsidization

In the context of the telecommunications industry refers to the allocation of cost prior to deriving any rates and represents the influence of other segments of the business on the particular segment of the business for which the rates are being derived. In particular, relates to the sharing of the costs of providing service between relatively lucrative and less or non-lucrative areas of operations in order to offer a common rate schedule.

Data

Information of any kind but generally, in communications, refers to digital data which is information represented by a code consisting of a sequence of discreet elements.

Data banks

Refers to any central storage of information but is commonly used to refer to related information stored in a computer, e.g., legal data bank, medical data bank.

Data-phone

The name applied by AT and T to the members of a family of devices used for providing data communications over telephone lines.

Data set

A device which converts the signals of a business machine to signals that are suitable for transmission over communications lines, and vice versa. It may also perform other related functions.

Data transmission

The transfer of digital information between two or more points via a communication system; radio, cable, wire.

Demodulation

The process of retrieving an original signal from a modulated carrier wave. This technique is used in data sets to make communications signals compatible with business machine signals.

Dial-up

A service which makes it possible for a dial telephone to initiate and carry out a station-to-station call for data-transmission purposes.

Digital

Pertaining to a system in which the message elements are evaluated in terms of discreet levels or values, and these are represented by a limited set of numbers or digits, e.g. 0 to 9 in the decimal system; 0 or 1 in the binary system.

Digital computer

A computer which operates with information that is represented in digital form, i.e., in discrete as compared to the continuous form used in an analog computer.

Display unit

A device which provides a visual representation of data.

EDS (Electronic-Data-Switching)

Trade Mark of Siemens AG for computer-controlled data-exchange at the Central Office.

Electrostatic Storage Tube

See Cathode Ray Tube Memory.

ESS (Electronic Switching System)

Bell System term for computerized telephone exchange. ESS 1 is a central office. ESS 101 gives private branch exchange (PBX) switching controlled from the local central office.

External Storage

Storage that is separate from the computer but which can be accessed by the computer when necessary, e.g., magnetic tapes, magnetic disk file, etc.

Facsimile (FAX)

A system for the transmission of images. The image is scanned at the transmitter, reconstructed at the receiving station, and duplicated on some form of paper.

Federal Communications Commission (FCC)

A board of seven commissioners appointed by the President under the Communication Act of 1934, having the power to regulate all interstate and foreign electrical communication systems originating in the United States.

Ferrite

A compound consisting of ferric oxide and a more basic metallic oxide.

File

An ordered collection of information.

Foreign attachments

A term used to describe equipment, i.e. telephones, modems, data sets, displays, etc., connected to a telecommunications carrier's facilities but which is not supplied by the carrier.

Full Duplex

Term applied to a communication channel over which both transmission and reception are possible in two directions at the same time.

General-purpose computer

A computer which can be programmed to solve a wide variety of different problems whose nature may not even be known to the original machine designers.

Geostationary

Stationary with respect to a point on the earth's surface. Thus a geostationary satellite is one located over the equator at a height such that it orbits the globe in the same direction and at the same rate as the earth rotates so that it remains directly above a given point on the earth's surface.

Hardware

The electrical, electronic and mechanical devices from which a computer is constructed.

Horizontal diversification

A term applied to an organization, i.e. a telecommunications carrier which enters a business different from its normal field by integrating the new activities into the original business organization.

Half Duplex

A term applied to a communications channel over which both transmission and reception are possible but in only one direction at a time.

Information retrieval

Techniques for storing and searching large quantities of information and making selected information available. An information retrieval system may or may not be a real-time system.

In-plant system

A system whose parts, including remote terminals, are all situated in one building or localized area. The term is also used for communication systems spanning several buildings and sometimes covering a large distance, but in which no common carrier facilities are used.

Integrated Data Processing

Information processing that is carried out according to a systems approach which takes into account the interrelationships of many different applications.

Interconnection

A term used to describe the connection between different telecommunications carriers and/or telecommunications carriers and private systems so that signals pass freely from one system or carrier to the other.

Interface

The boundary between two systems, subsystems, or devices.

International Telecommunication Union (ITU)

The telecommunications agency of the United Nations, established to provide standardized communications procedures and practices including frequency allocation and radio regulations on a world-wide basis.

Large-Scale Integration (LSI)

A technique used to produce microelectronic components which contain a large number of circuit elements on a single surface (Chip). LSI refers to any whole-function subsystem on a single chip capable of operating independently of other parts of the system. LSI devices are also used for memory systems.

LASER (Light Amplification by Stimulated Emission of Radiation)

A device for the generation of coherent light energy which results in very intense and sharply defined beams.

Line switching

Switching in which a circuit path is set up between the incoming and outgoing lines. Contrast with message switching (q. v.) in which no such physical path is established.

Library

A collection of programs and subroutines for solving problems of many different types.

Local line, local loop

A channel connecting the subscriber's equipment to the line terminating equipment in the central office exchange. Usually metallic circuit (either two-wire or four-wire).

Magnetic core

A doughnut-shaped ferrite material characterized by a nearly rectangular hysteresis loop and capable of assuming either of two stable magnetic states.

Magnetic-Core Memory

An information-storage system in which the data are stored in magnetic cores.

Magnetic-Disk Memory

A storage system in which data are recorded on and read from revolving magnetic oxide coated disks.

Magnetic Drum Memory

A storage system in which data are recorded on and read from the surface of a revolving drum coated with magnetic oxide.

Magnetic-Tape Memory

A storage system in which data are recorded on and read from a long strip of moving magnetic oxide-coated tape.

Mass Storage System

A high-capacity storage system, external to but under the control of the computer, used for the storage of bulk data such as tables, files, and subroutines.

Master/Slave System

A system in which one computer exercises control over the activities of another computer. Usually the "master" machine controls input and output, and schedules and supplies jobs to the "slave" machine. The slave computer is, in general, the one with the greater capability, and it performs most of the computational tasks.

Medium Scale Integration (MSI)

Indicates a level of integration or the number of circuits per chip. With MSI is understood everything which is under 50 to 100 circuits per chip.

Message Switching

The operational procedure of receiving a message at an intermediate point, storing it until the proper outgoing line is available and retransmitting it.

Modem

An abbreviation used to designate units or equipment panels containing both a modulator and a demodulator.

Multicomputer system

A computing system containing two or more simultaneously active computers.

Multiplexing

The act of combining signals for many different sources into a common channel. This function is often performed by a multiplexor.

Multiplexor

A device, often a stored-program computer, which handles the input/output functions of an on-line computing system having multiple communication channels.

Multiprogramming

A technique which permits a single computer to simultaneously run many different programs.

Network

A series of points interconnected by communications channels. A switched-telephone network is the network of telephone lines normally used for dialed telephone calls. A private-line network is a network of communications channels confined to the use of one customer.

Noise

Random electrical signals; introduced by circuit components or natural disturbances, which tend to degrade the performance of a communications channel.

Off line

1. Term applied to a system which does not process its input data as they are received but instead stores and processes them at some later time.
2. Also applied to auxiliary equipment, input-output devices, etc., which do not operate under the direct control of the central processing unit.

On line

1. Term applied to a system in which input data are processed as they are received and output data are transmitted immediately as they become available to the point where they are needed.
2. Also applied to auxiliary equipment, input-output devices, etc., which operate under the direct control of the central processing unit.

Program

The group of related instructions which when followed by a computer will solve a given problem.

Programming

The art of preparing a set of terms and instructions which a machine can understand and obey and which when followed by that machine will result in a solution to a given problem.

Private (leased) - Line

A communications channel or circuit provided to a subscriber for his exclusive use.

Pulse-Code Modulator (PCM)

A system of modulation in which the message waveform is sampled at a prescribed rate and each sample is quantized and then coded in terms of pulses, where the height, width or position of a pulse has a definite code meaning.

Pushbutton dialing

The use of keys or pushbuttons instead of a rotary dial to generate a sequence of digits to establish a circuit connection. The signal form is usually multiple tones. (Also called tone dialing, Touchcall, Touch-Tone.)

Raw Computer Power

The facilities portion of a Computer Utility. This includes basically the central hardware and executive system but might, in some cases, also include terminal equipment on the customer's premises and certain compilers and information retrieval control programs.

Random Access Storage

A memory in which the access time to each record is independent of the location of the preceding record.

Read

The act of obtaining information from a storage device and transferring it to some other device.

Read-Only Memory

A memory whose contents can be changed, if at all, only by off-line human intervention usually involving rewiring, the removal or insertion of plugs, or the punching of holes.

Real-Time Computer System

One which receives data, processes them, and returns the results to the data source in a time that is compatible with the response time of the process or system that is generating the data.

Record

A set of related facts or data that is treated as a unit.

Remote access

Refers to a communication service which permits connection to a central facility from a remote point, generally via a telecommunication system.

Service bureau

An installation from which a user can lease processing time on a central processor and peripheral equipment. The user supplies the programs, and the service bureau loads the program and the data to be processed, processes the data, and delivers the results to the user. The program and data for processing may be delivered or sent to the centre by the user in any of several forms: cards, punched tape, magnetic tape, etc. Data communications may be used between the user and the centre to move the information electronically. The service bureau may also provide such services as keypunching the data and preparing them for processing.

Software

Software may be defined as a group of standard programs and processes necessary to operate a computer. It can be divided into two levels: basic and auxilliary.

Basic software

Basic software consists of programs essential to the operation of the computer, the major group of which is now called the Operating System. An operating system performs such functions as Error Detection and Recovery, Communication with Peripheral Devices for Input and Output, File Handling, Interrupt Handling, Priority Assignment, Storage Allocation and Communication with terminal configurations.

Auxilliary software

Auxilliary software consists principally of standard programs designed to allow customers to write their application programs in "high level" languages.

Special-purpose computer

A computer designed to solve a specific problem or class of problems.

Storage

1. A memory.
2. A general term for any device capable of retaining information.

Store-and-forward

Process of message handling used in a message-switching system.

Tariff

The published charge for a service or piece of equipment provided by a communications utility.

Teleprocessing

A form of information handling in which a data processing system utilizes communications facilities.

Telpak

A special AT and T tariff for leasing wideband communications channels.

Terminal

(1) A point at which information can enter or leave a communication network.

(2) An input/output device designed to receive or send source data in an environment associated with the job to be performed and capable of transmitting entries to and obtaining output from the system of which it is a part.

Time Division Multiplexing (TDM)

The process of transmitting two or more messages or signals over a common transmission path by allotting a different portion of time to each signal. Thus, the pulses from a number of channels are interlaced to form a single series of pulses.

Time-shared computer

A computer which switches from customer to customer at a rapid rate under the control of a scheduling formula that in the simplest case is an ordinary round robin. Each user's program is thus run in the form of short bursts of computation, and all programs are time multiplexed together in a continuously repeating cycle.

Thin-film memory

A memory which stores information magnetically in thin oriented metallic films.

Touch-tone

A service mark of the American Telephone and Telegraph Company which identifies its pushbutton dialing service.

Vertical diversification

A term applied to an organization, i.e. telecommunications carrier, which enters a business different from its normal field by establishing a separate corporate subsidiary for conducting the new business.

Voice grade channel

A channel suitable for transmission of speech, digital or analog data, or facsimile, generally with a frequency range of about 300 to 3,000 cycles per second.

Wide Band

A relative or qualitative term used as a general measure of bandwidth in terms of relatively narrow or broad. A spectrum or energy covering a wide frequency range. (For example, a single telephone channel would be considered as narrowband whereas a cable or microwave system would be considered as broadband.)

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